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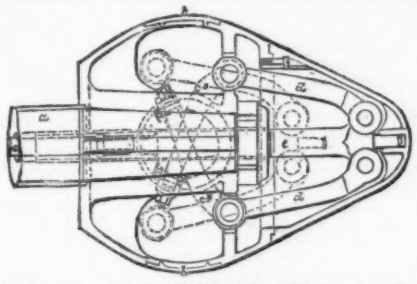
THE BEVIS ADJUSTABLE PROPELLER.

THE want of an efficient arrangement for altering the pitch or feathering the blades of a screw propeller in a fore-and-aft direction, particularly for ships of war, sailing ships with auxiliary power, and yachts, has been long recognized, and this seems to have been accomplished by the arrangement patented by Mr. R. R. Bevis in 1868, and now being extensively adopted. A screw propeller of the ordinary kind, whether fixed or moving, is a heavy drag against speed and handiness for sailing; and lifting is a laborious operation, and requires a large well or aperture through the ship's counter to admit of doing so. The arrangement of Bevis' screw, illustrated by the engraving above, is open to very few of the objections made to feathering screws previously tried. The levers and other gear for moving the blades are enclosed in the boss of the propeller, and are attached to a rod passing through the centre of the shaft, and worked in the screw shaft tunnel, so that the gear as well as the men working it are protected. This in ships of war is an important consideration.

Our engraving shows the feathering propeller as lately fitted by Laird Brothers to H.M. gunboats Griffin and Falcon, each of 750 indicated horse power, which vessels have



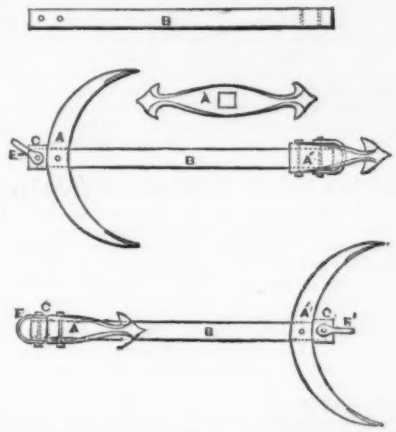
recently completed their official trials at Plymouth. During the trials of one of these vessels the gear was put into requisition, as after completing one series of runs it was considered desirable to alter the pitch of the screw, which was done in the course of a few minutes, when she was again put on the mile to complete another series; this operation, with the ordinary "lifting" screw, would have involved some considerable delay, or, if not fitted with lifting gear, would have necessitated putting the vessel into dry dock.

These two are the only vessels in the Royal Navy actually at work with this gear, but the Garnet, 2100 indicated horse-power, and the Cormorant, 900 indicated horse-power, are now being fitted with it. The same arrangement of gear has been fitted in ships belonging to several foreign Governments, and in a large number of yachts, notably to Mr. Brassey's Sunbeam, which has recently circumnavigated the globe in forty-six weeks, sailing or steaming at intervals as circumstances required, during which time this feathering arrangement was found to be useful and handy, and is reported as thoroughly successful, and as not having been out of order.

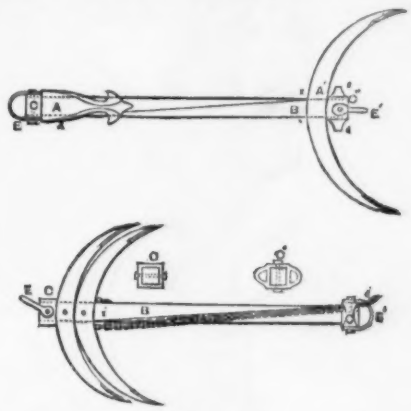
Referring to the detail cut, *a* is the propeller shaft, *b* the boss affixed to its end, and carrying the screw blades, the shanks of which are formed with a collar c^2, which abuts upon a face formed for it on the boss, and is so held by a cap made in two parts. Fixed in the shank of each blade is an arm or lever, c^3; it passes through slotted openings in the socket formed in the boss to receive the shank, and by a link *d* it is connected to the end of the rod *e*. This rod passes through the last length or lengths of the propeller shaft, and is capable of being slid endwise to and fro within it. Into a slot in the opposite end of this rod is fitted a cross bar, the ends of which pass through slots in the propeller shaft, and are embraced by the two parts of a nut, which works on a screw thread on the exterior of the shaft. When the nut is turned, by means of levers, the key, and consequently the rod *e*, are caused to travel along the shaft, and the shanks of the propeller blades will thus be turned in their sockets, and the propeller blades so set at any desired angle to the shaft.—*The Engineer.*

CAPT. SWINBURN'S PORTABLE ANCHORS.

WE illustrate in the accompanying engravings an anchor invented by Capt. Thos. A. Swinburn, R. N. The first



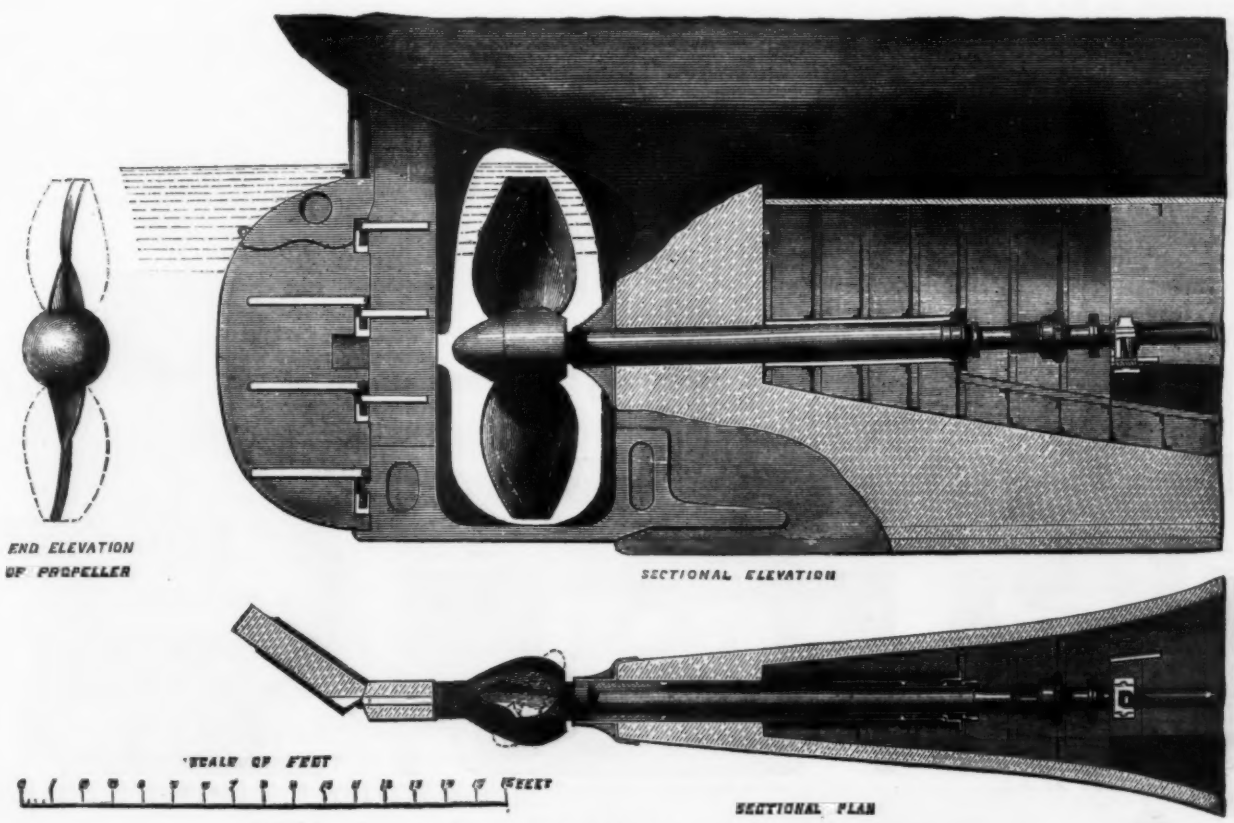
engraving shows a reversible portable anchor, No. 3 C. This form is best adapted for general purposes, and especially to be carried as a spare anchor. It is very simple in construction, the shank being a square bar, in each end of which are two holes through which bolts are passed, securing the arms, stock, and collars. The two holes at each end are parallel to each other, but at right angles to those at the opposite end. The two pairs of arms are exactly alike, so that one pair can be used as a stock. There are two collars and two shackles, the shackle at the crown of the anchor serving to hook the fish to. These collars support the bolts, securing arms, and stock. All these parts being exactly alike are interchangeable, the anchor can be



put together or taken to pieces with great readiness, and can be easily stowed away either together or separate, in places not available for other anchors. By using a pair of arms as a stock, greater holding power is gained as well as greater certainty of acting.

Another advantage is handiness in laying out to heave off a stranded ship, as the parts could be carried in separate boats; if carried as a spare anchor, one might be converted into two. Another is strength of parts, there being no welding.

The second engraving shows a portable anchor, No. 6 B. This is a modification of the foregoing, and is especially adapted for turret ships, as the stock, when not in use, is in the same place with the arms. The shank is a square bar with a twist, a quarter turn between the points—*x* and *x* in the drawing—the first pair of arms is secured to the shank by a bolt, and further supported by a collar at the crown. The second pair of arms, which likewise forms the stock, when not in use lies close to the first pair, but when let go the strain of the cable causes it to slide along the shank till



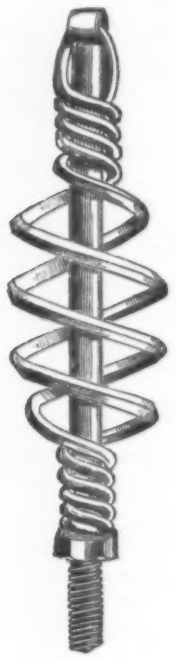
THE BEVIS ADJUSTABLE PROPELLER.

it is brought up against the second collar; it is then at right angles to the first pair of arms, and will remain so as long as there is a strain on the cable.

The cable is shackled to two parts of a bridle, the ends of which are shackled to two bolts riveted through the second pair of arms or stock, and passed through fairleads on the second collar. The two shackles on the ends of the shank are for cat and fish. This anchor, like the last, has great holding power, but is easily broken out of the ground in weighing; it comes awash with the stock at right angles, but after hooking the cat, the stock slips down as the anchor comes up to the cathead. As it is lifted with the weight of both arms together, extra strength of fish gear is needed.—*The Engineer.*

RASTRICK'S TUBE-SCRAPER.

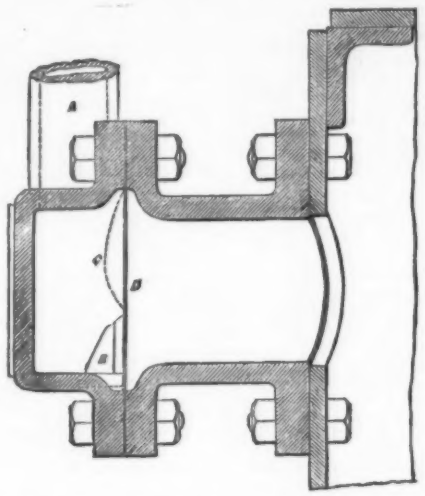
We illustrate herewith a very simple and effective boiler tube-scraper, invented, says the London *Engineer*, by Mr. Rastrick while out at sea, and hard pushed for a scraper. It looks very much like an American patented article in the same line. The steel wire of which they are formed is square at the scraping part, and round where it curls round the rod. It has not been explained to us how these spirals are made,



but it must have proved a more difficult task than it might at first sight be thought. The diameter of the central spires can be altered through a small verge by screwing or unscrewing the nut on the bar carrying it. It is as simple as it can possibly be, is not liable to choke, and will yield to any inequality in the tube: and by winding coir or other suitable material between the coil a brush and scraper can be combined. It is manufactured by Messrs. Salter, West Bromwich, Eng.

ROWAN'S SAFETY DISC FOR BOILERS.

The accompanying sketch illustrates a safety apparatus invented by Mr. W. Rowan, C.E., York street, Belfast. The safety disc D is made of light sheet copper, and as the pressure in the boiler increases, the disc is pressed against the brass stop B, and when the pressure increases, say 50 lb. to the square inch, or other working pressures, the disc takes the form of the curved line C, and as the steam gets higher in pressure—say 55 lb., or more—the disc becomes strained to such a degree that it is fractured against B, and the steam escapes through the pipe A, which will prevent all danger, and reduce the pressure to a point of safety, while the fireman is warned that the boiler is loaded beyond the fixed pressure. It will then be his duty to draw the fires, and have the safety-valves examined, to ascertain the cause of the pressure being in excess. It is to be observed that the disc is by far the weakest part of the boiler, and from its automatic action it is admirably adapted to prevent explosion from over-pressure, provided the safety-valves are adjusted to act at a point of safety. Mr. Rowan has carried out a series of experiments for Mr. Greenhill, of Belfast,



and in each case the result was very satisfactory. The discs which were tried were equal to 40 lb. pressure per square inch, and at the moment when the Bourdon gauge indicated that amount, a slight hissing noise, followed by a copious discharge of steam, showed that they fractured at the intended pressure.—*The Engineer.*

IMPROVED SLUICE VALVES.

The engravings illustrate an improved sluice valve by Bagshaw and Sons, Victoria Foundry, Batley, Eng. It will be seen that the valve is in equilibrium, so that in working, it is free from the disadvantages attending many valves for the same purpose; such as breaking the lifting spindle, sticking of the valve, and the loss of time which so often takes place with the ordinary sluice under the pressure of a considerable head. The valve illustrated requires no head gear, and, as will be seen from the design, will work smoothly under any pressure. It is very simple, and we believe that those who know the difficulties which frequently attend the use of the common valve will appreciate this improvement. The makers were led to design it from the fact that it takes three men about a quarter of an hour to open a common 20in. valve at a reservoir near their works.

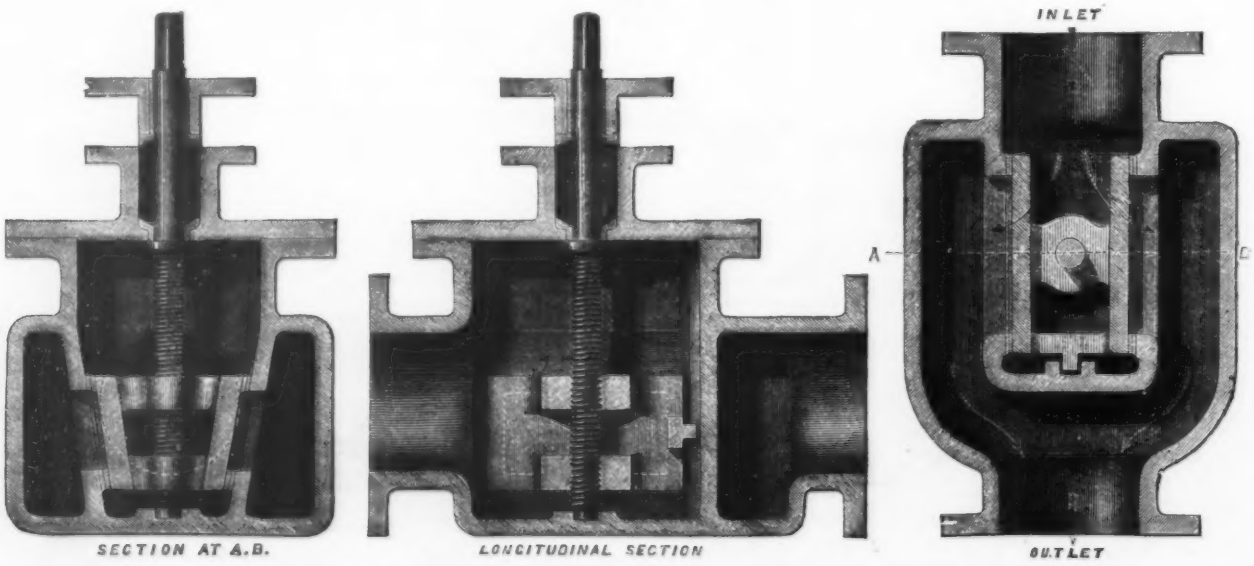
AMERICAN LOCOMOTIVES IN AUSTRALIA.

On the recommendation of the Engineer-in-Chief, the Victorian Government recently sent to America for a pair of locomotives similar in construction to those in general use on the American railroads and combining all the latest improvements. An order was sent to the establishment of Rogers & Paterson, New York [*sic*], one of the most extensive works in the States for the manufacture of locomotives, and the machinery recently arrived. Both engines are to be be fitted up at the Williamstown workshops, under the supervision of a mechanic sent out specially by the manufacturer. The erection of one of these was so far completed as to allow of steam being generated in the boiler for the first time yesterday, and an opportunity was afforded a number of persons of seeing the locomotive outside of the shed, although it was not quite ready to be set in motion. The appearance of the locomotive is totally different to the English make, being more showy. Most of the working parts are more exposed, and, as they are polished and painted off in various colors, they appear very attractive. The locomotive is purely of the American style, with outside cylinders and steam-chest on top. The valves are worked by a rocking shaft, with eccentrics from the driving axle. The diameter of the cylinders is 17 in. and the stroke 22 in. The driving-wheels are five feet high, four coupled. The fore part of the engine rests on a bogie truck, in which the principles of no less than six inventions are combined. The bogie wheels are made entirely of chilled cast iron, and the bogie truck is considered to be thoroughly perfect in mechanism, and as good an adaptation of the principle as could be desired. The driving-wheels are made of cast iron bound with steel tires 2¼ in. thick, the spokes being made hollow, so that the engine might not be too heavy. The boiler is so constructed that either wood or coal may be burnt in it. The fire-box is made of steel and the tubes of wrought iron. In the English-made locomotives the fire-boxes are made of copper and the tubes of brass. The working parts of the engines, such as the pumps, the injectors, mountings, and fittings, are of entirely different patterns to those in English locomotives. The total weight of the engine is about thirty tons. The driver's shed is a really handsome structure. It is made of beautifully polished walnut, and is ornately finished. This addition to the locomotive forms one of its attractive features, the contrast with the miserable, dirty-looking covers on the locomotives now on our lines being very striking. It is said that the walnut is not introduced for the purpose of ornamentation, although there can be no doubt as to its being a great improvement, but simply because it is as cheap as pine, where the engines are constructed, and because it is less liable to the accumulation of dirt. The tender is of very light construction indeed, being mounted on a wooden frame. It is supported on double bogie wheels, smaller and lighter than those which bear the weight of the fore part of the engine. In addition to the steam-chest a sand-box made in the shape of a dome is fixed on the top of the boiler, and the sand is conducted to the wheels by small pipes. As most of the American railroads are not fenced in, one of the most necessary adjuncts to the fore part of the locomotive is a strong reflecting lamp, for night traveling, and one of the very latest make in use there has been forwarded with the engine. It is of immense size, being two feet wide, three and a half feet high, and two feet deep, and is placed on a projecting platform at the bottom of the smoke funnel. The glass in front is two feet in diameter, and the reflector is formed in the shape of a parabole. This reflector is composed of copper, with the face silver-plated. A circular kerosene burner is set in the extreme end of the parabole, and it is said that when it is lighted up a strong flood of light is shown a distance of a quarter of a mile away. What a glorious transformation from the dusky lamps now fixed on our trains, which only serve, by the feebleness of their rays, to increase the surrounding gloom, shading objects which would otherwise be quite discernible! The only object for which these lamps can be useful is that of showing the unwary traveller or the vigilant gateman the approach of the hissing monster which defies all impediments to its onward progress. But with the lamps patented by J. A. Williams, of Utica, N. Y., quite a different effect will be produced, as, by the brilliancy and power of the light which it throws forth, any driver with a good night eye, as it is termed, will be able to see any obstruction on the line long before he comes to it. The lamp in question displays splendid workmanship, and is well worthy of inspection. Should it prove the great success which is anticipated of it, there is every likelihood of its being brought into general use here. On the corners of the front of the engine there is an apparatus for displaying signal flags, but as these are not used on our lines the fixings will be removed after they have been kept on for a short time, so as to show the people of the colony the latest notions emanating from the inventive mind of the Yankee. The total cost of the two engines was $18,000, but to this amount was added $1,628.27 under the head of charges, and £370 for freight. This would make the total cost of the two engines landed at the Williamstown shops about £4,625, and to this will have to be added the cost of erection, which will not be very considerable. The officers of the department are not prepared at present to offer any opinion as to whether these locomotives will be of any greater advantage than those made according to English patterns; but as the one just fitted up will have a fair trial in a week or so, they will be then able to form a conclusion. We understand that it is contemplated to run the locomotive with a passenger train for the first time to the opening of the Colac Railway.—*Melbourne Age.*

200 H. P. HORIZONTAL ENGINE.

Our engraving is an example of horizontal engines made in Edinburgh, Scotland, by Messrs. Bertram, lately, with boilers, subjected to test by L. E. Fletcher, Chief Engineer of the Manchester Steam Users Association. The object of the trials was to ascertain the economic efficiency of a new patent water pipe boiler by Messrs. Sinclair, of the Albion Boiler Works, Leith, as well as of a new engine by Messrs. Bertram, of Leith Walk Foundry, Edinburgh.

Boiler.—The Sinclair boiler consists of a number of water pipes slightly inclined to the horizon, and laid in rows one above another; these pipes running at each end into a flat, stayed, waterspace placed nearly vertical, and opening at the top into two cylindrical vessels, 4ft. in diameter, and 16ft. 9in. long, which run longitudinally over the stack of water pipes,



BAGSHAW'S IMPROVED EQUILIBRIUM SLUICE VALVES.

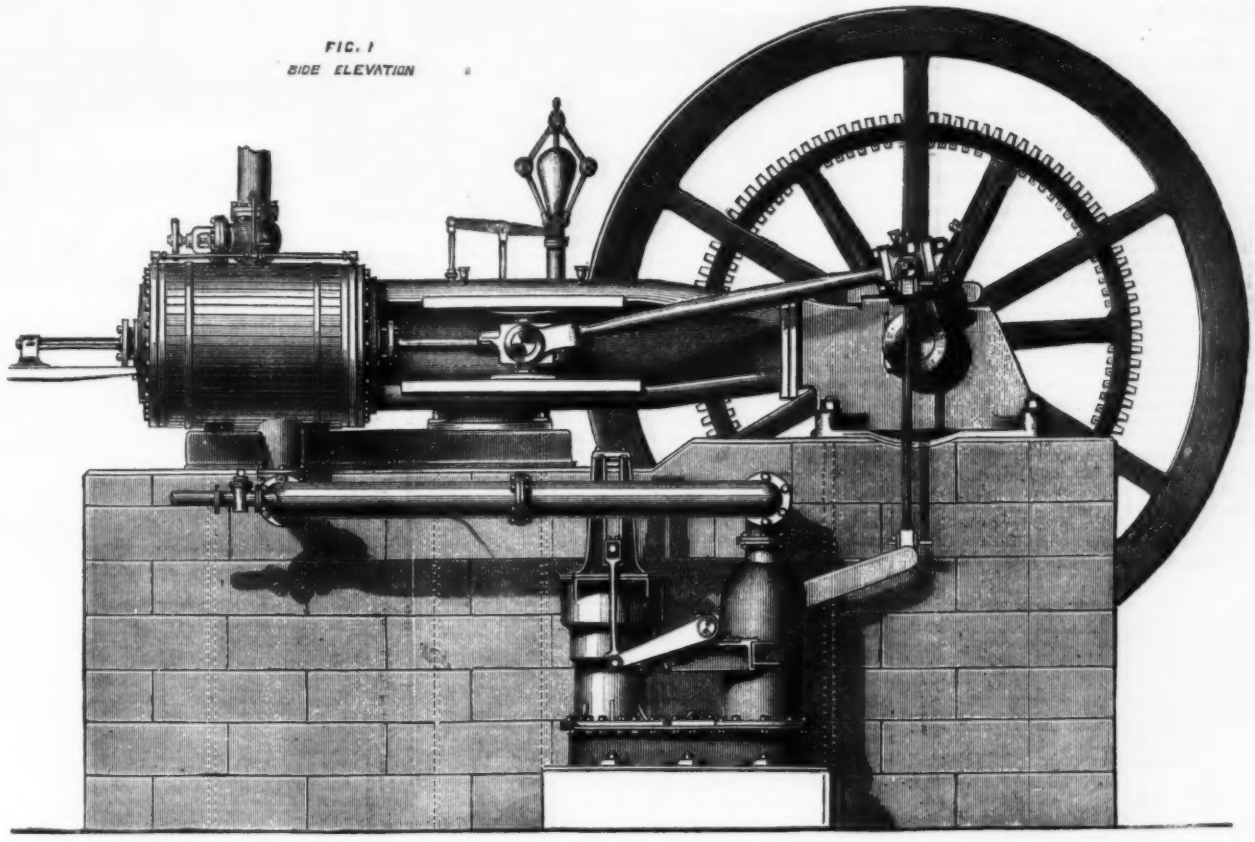
and serve the purpose of separators for the steam and water. It may be pointed out that in this arrangement all the water pipes are below water line, which is not always the case in water pipe boilers. This boiler contains 115 water pipes 11ft. 9in. long, 100 of these pipes having a diameter of 5in., while the length of the firegrate is 6ft., and the width 6ft. 7 in. Thus the heating surface of the boiler is 1507 square feet. The accompanying diagram gives a front view of Messrs. Sinclair's boiler.

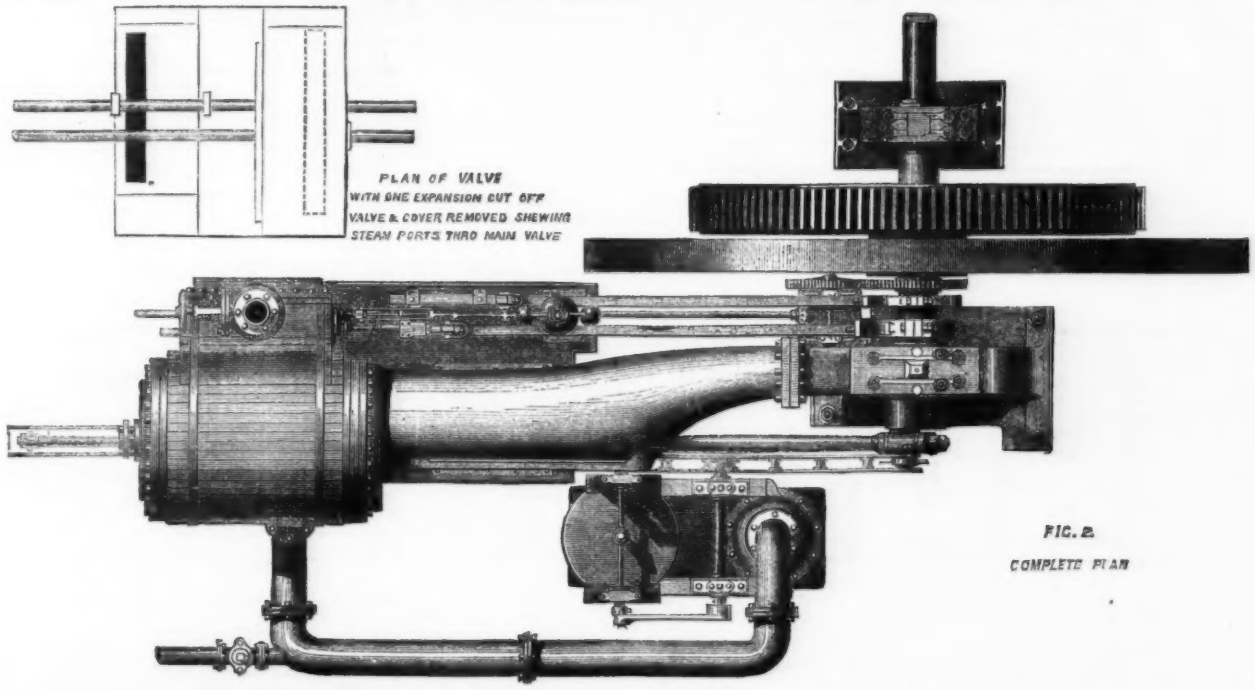
The result of the test was the Sinclair boiler evaporated 7·23 lb. of water per 1 lb. of coal from a temperature of 88·8 deg., at a steam pressure of about 35 lb., the rate of combustion being 16·6 lb. of coal per square foot of firegrate per hour, and the rate of evaporation being one cubic foot of water per hour for every 19·85 sq. feet of heating surface.

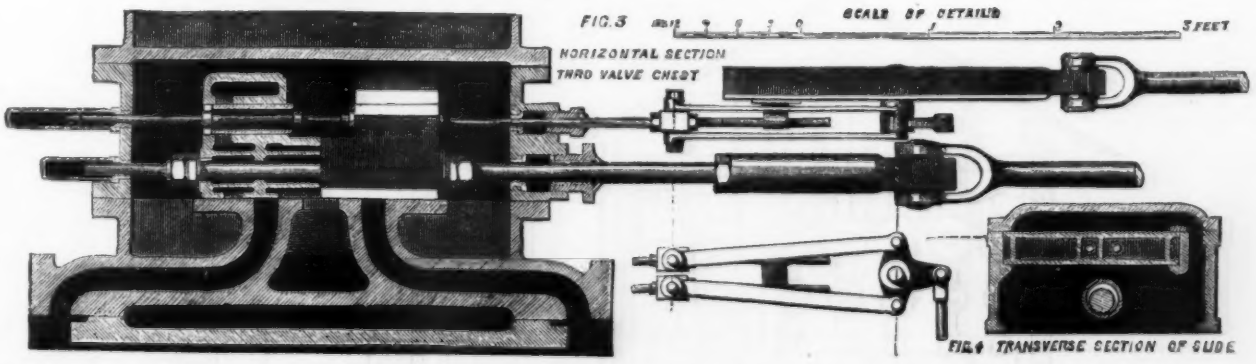
Engine.—The engine is of horizontal condensing construction, having one cylinder only, which is steam-jacketed, both in the barrel and at the ends, fitted with a Dack's cut-off valve, regulated by a high speed governor of the Porter type. The engine has no throttle valve, but is regulated entirely by the cut-off valve, the compass of which extends from zero to three quarters of the stroke of the piston. The engine has a stroke of 3ft. 6in., a diameter of piston of 30in., and runs at about 52 revolutions per minute. The air pump is 20in. in diameter. The clearance and chamber room at each end of the cylinder is as follows:—

	Cub. in.
Capacity of main steam port, 18in. transversely × 2¼in. longitudinally × 31in. length of passage	= 1255·5
Capacity of cover of cut-off valve	= 150·0
Capacity of main slide valve—one end only	= 345·0
Clearance of the piston at end of cylinder 30in. diameter × $\frac{5}{16}$in.	= 220·6
Total clearance and chamber room at each end of cylinder	cubic inches = 1971·1

Thus the steam ports have an area equal to one seventeenth of the piston, while the total chamber room of the steam passages and piston clearance at the end of the cylin-







HORIZONTAL ENGINE. CRAIG'S PAPER MILL, DALKIETH. BERTRAM, LEITH WALK FOUNDRY, EDINBURGH, ENGINEERS

der is one fifteenth of the capacity of the piston sweep of one stroke. The steam pipe connecting the engine to the Sinclair boiler is 61ft. long, the first 23ft. being 7in. in diameter, and the remainder 6in in diameter. Between the junction valve on the boiler and the stop valve on the engine there are seven elbows, as well as an intermediate valve. The steam pipes connecting the engine to the nearest Lancashire boiler, to which reference will be made in the course of this report, is 70ft. long, the diameter being 6in. throughout. Between the junction valve on the boiler in this case and the stop-valve on the engine there are seven bends. In both cases the pipes were substantially covered with Fleming's composition.

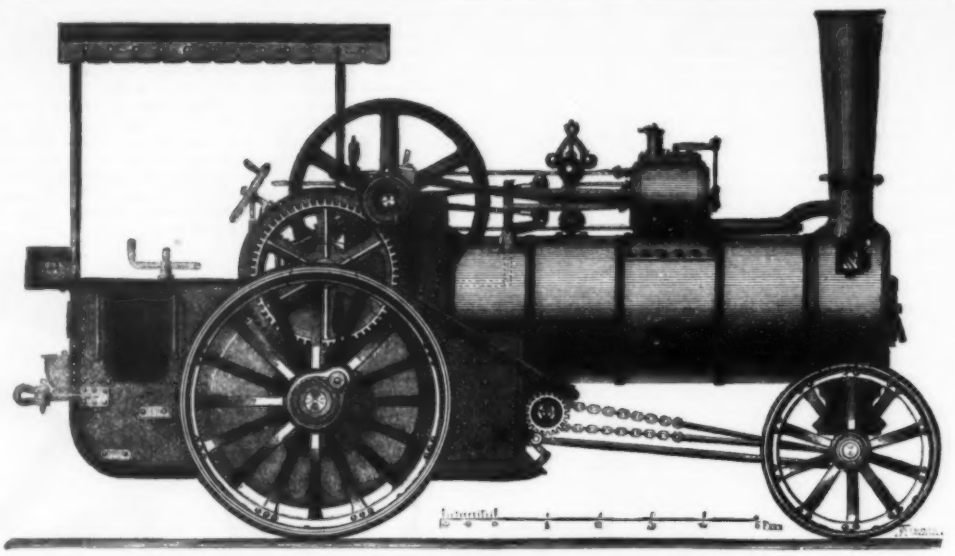
The table of the performances of the engine gives 195·7 indicated h. p., and 2·56 lbs. coal per I. H. P. These are good results. Our drawing is from *The Engineer*.

ROAD AND AGRICULTURAL LOCOMOTIVE.

We give an engraving of an eight horse power agricultural locomotive, constructed by Messrs. Wallis and Steevens, of Basingstoke, Eng. Although there are embodied in the design of this engine no great novelties, yet care has been bestowed on its arrangement, and it has been endeavored, says *Engineering*, to produce an engine that shall be substantial and in which all details shall be easily accessible.

The cylinder, which is thoroughly steam-jacketed as well as protected by lagging, has an ample bearing on the boiler barrel, to which it is firmly bolted. Two safety valves are placed on the top of the cylinder, in communication with the jacket, one lock-up screwed down to blow off at 150 lb. pressure and fitted with easing lever, and one spring balance. The crankshaft brackets consist of two wrought-iron plates, ½ in. thick, fixed to the boiler barrel, and to which the main bearings are secured, these plates being stiffened sideways by flanged cross plates back and front rivetted to them. The crankshaft main bearings are fitted with wedge-motion horizontal adjustment instead of the side set screws that are very commonly used. The main axle and countershaft have carriages bolted to hornplates, which are prolongations of the firebox sides, in the usual manner. These plates are ½ in. thick, and the carriages have bosses projecting through them so as to relieve the strain on the bolts.

An efficient damper is fixed in the chimney base below the exhaust nozzle, this damper being capable of regulation from the footplate for preventing the smoke nuisance when passing through towns, &c. The engine is fitted with two



ROAD AND AGRICULTURAL LOCOMOTIVE.

speeds, with throwing-out lever and quadrant as shown; the driving pinions and clutch and the spur gear being of malleable iron.

The steering barrel has a disc cast on it at each end for the attachment of the steering chains; the chains are crossed. The steerage is worked from the footplate. This engine was not fitted with compensating gear, as many buyers object to it and prefer the less complicated driving pins, but provision has been made for applying this gear when required. A powerful screw brake is applied. One special feature consists in the off side of the tender being cut away as shown, having handles on each side and steps for facilitating the access to the footplate.

The fore carriage is all of iron with ball-and-socket joint. The smokebox door is fastened by a central cam working three bolts, which when driven tight draw the door up close to the face of the smokebox. The casing over the second motion gearing is not shown on the general view. The following are the principal dimensions of the engine:

Diameter of cylinder, 9½ in.
Length of stroke, 12 in.
Diameter of crank shaft, 3¾ in.
Diameter of flywheel, 4 ft.
Speed of governors, 175 revolutions per minute.
Speed of engine, 155 revolutions per minute.
Slow speed driving pinion, 12 teeth.

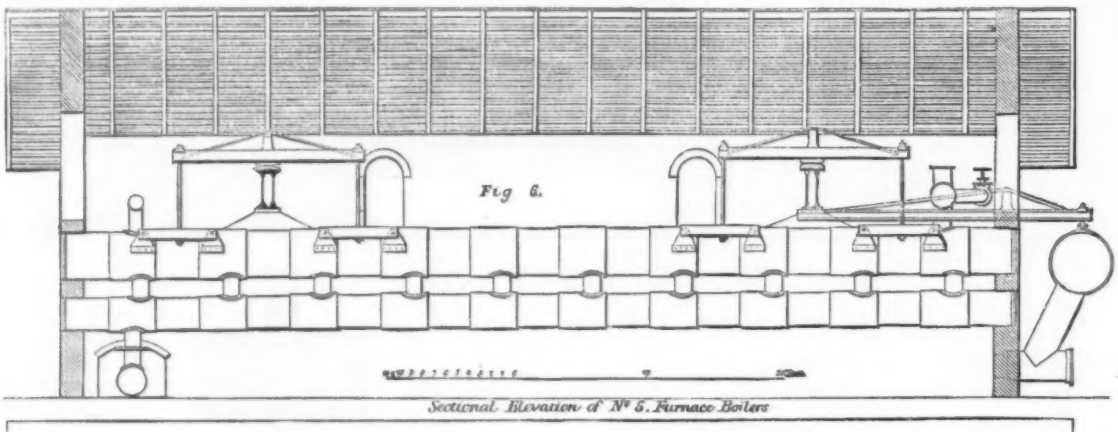


Fig 6.

Sectional Elevation of N° 5. Furnace Boilers

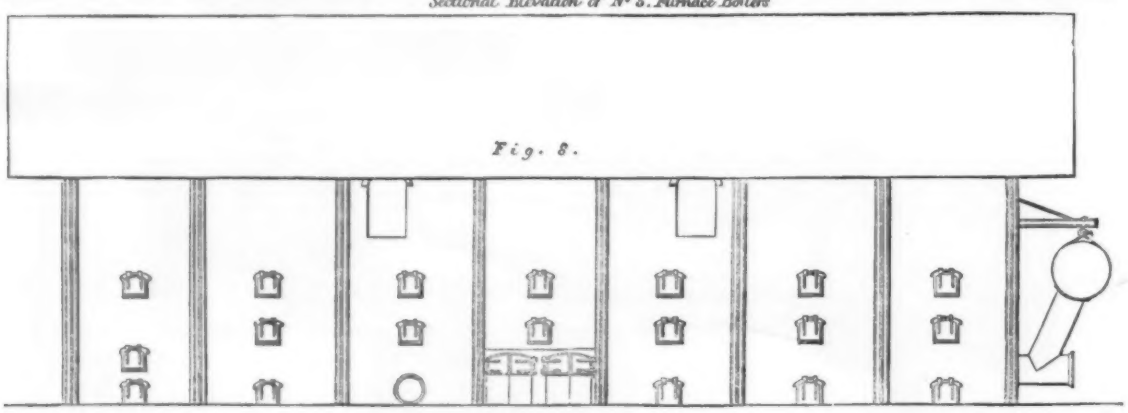


Fig. 8.

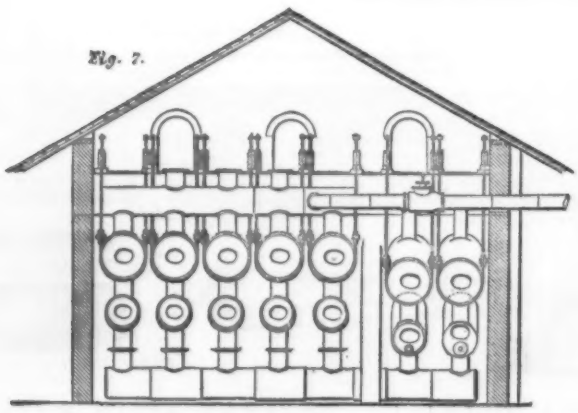


Fig. 7.

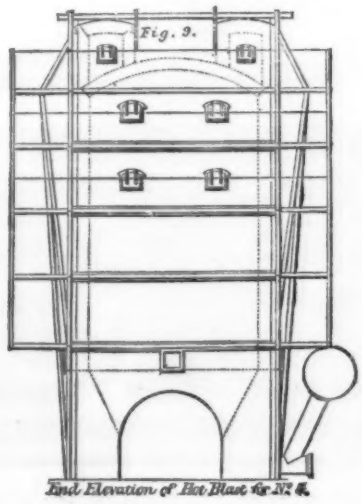


Fig. 9.

End Elevation of Hot Blast for N° 4.

BLAST FURNACES OF THE BETHLEHEM, PA., IRON WORKS.

Quick speed driving pinion, 20 teeth.
Slow speed wheel on countershaft, 66 teeth.
Quick speed wheel on countershaft, 58 teeth
Spur pinion on countershaft, 13 teeth.
Spur wheel on main axle, 52 teeth.
Driving wheels, 5 ft. 6 in. in diameter by 16 in. on face.
Leading wheels, 3 ft. 6 in. in diameter by 9½ in. on face.
Main axle, 5 in. in diameter.
Countershaft, 3½ in. in diameter.
Front axle, 3½ in. in diameter.
Slow travelling speed, 1.32 miles per hour.
Quick travelling speed, 2.64 miles per hour.
Maximum working steam pressure, 150 lbs. per sqr. inch.
Grate area, 6.5 square feet.
Total heating surface, 150 square feet.
Amount of coal carried, 10 cwt.
Amount of water carried, 140 gallons.

WORKS OF THE BETHLEHEM IRON COMPANY.

By A. L. HOLLEY and LENOX SMITH.

IN the present article it is proposed to briefly describe the two new blast furnaces, Nos. 5 and 6, in some detail, excepting their compound blowing engines.

These furnaces differ in many details from the usual type of furnaces of their class in the United States, and they combine many valuable results of experience. They were designed by and constructed under the superintendence of Mr. John Fritz, who is a famous authority abroad as well as at home, in connexion with the iron manufacture.

Fig. 4 is an elevation, partly in section, of the pair of stacks and of the stoves, boilers, &c. Their position, as well as that of the blowing engines *a*, *c*, *d*, *e*, *f*, *g*, *h*, and the pumping engines *i*, *j*, *k*, *l*, are shown by Fig. 5 on the present page. The compound engine *a* is not yet completed. The two furnaces, and also No. 2, are run by the compound engine *c* and the two engines *d* and *e*, all of which are of the same power. The air cylinders are 80 in. by 80 in., and the revolutions are 24 per minute.

The peculiarities of general arrangement, such as widely separating the stacks (225 ft.) and putting the engines on the other side of the stock house, have been well studied. The stacks are separated in order to get the stoves *m*, *p*, Fig. 5, and the boilers *r*, *t*, close to them in a convenient manner, and also in order to have the supplementary stoves *n* and the supplementary boilers *s* convenient to both furnaces. The intention was also to get the necessary stock floor around each furnace in a long house (451 ft. by 61 ft.) running, with its straight railways, parallel to the line of furnaces, rather than to get this room less centrally by a narrow house running, with its necessarily curved railways, in the other direction. The stock hoists at *u* and *v* command within a very short distance a large floor space, under two railways. The stacks are also separated in order to keep the casting-houses far apart for the sake of ventilation, and to make better space for the boilers. The heat of a double casting-house, where stacks are close together, is a serious matter in a warm climate. The gas connexions from the stacks to the stovesand boilers are not longer than they would be under other usual arrangements.

The furnace stacks are of the following dimensions: No. 5 is 70 ft. high and 17 ft. 2 in. in diameter at the bosh. No. 6 is 70 ft. high and 18 ft. 6 in. in diameter at the bosh. It will be observed (see Fig. 4) that instead of being enveloped by an outer shell of plate iron the stack is enclosed by a system of rings and vertical bars of iron which have a uniform width of 9 in. throughout; the lower courses are 1 in. thick, and the courses decrease in thickness toward the top to ¾ in. The vertical bars are also similarly reduced in thickness toward the top of the furnace, their thickness at the bottom being 1 in. The joints of the rings and bars are 2 ft. apart from centre to centre at the base of the furnaces. This forms a stronger system of bracing than an exterior shell of plate iron of equal weight, as it does not, like the latter, tear apart in detail; besides which it possesses important advantages in other respects over a plate-iron shell, especially in respect of the facility with which repairs may be made. The outer walls of the furnaces are ventilated by means of two holes situated in each of the spaces between the bracing, and which extend through the masonry surrounding the loam lying next to the lining. The outer walls are similarly traversed by vertical holes. By this means overheating of the outer walls, and consequent straining of the bracing, is prevented, and the exact point where gases may be escaping is readily detected. In case the lining of the furnaces becomes thin, the outer masonry may be cut into between the bracing, and the damage quickly and effectually repaired at the least possible cost.

The arrangement of the tuyeres also combines some novel and practical features. Besides the four or five working tuyeres, auxiliary or "fighting" tuyeres are placed about 16 in. or 18 in. above the former, and fitted in embrasures specially intended for them. These tuyeres are ready for immediate use in case of need, and derangements in the working of the furnaces are thus provided against. The furnaces also have spare cinder notches, which are fitted with Lurman's closed front, and may be used at a moment's notice in an emergency.

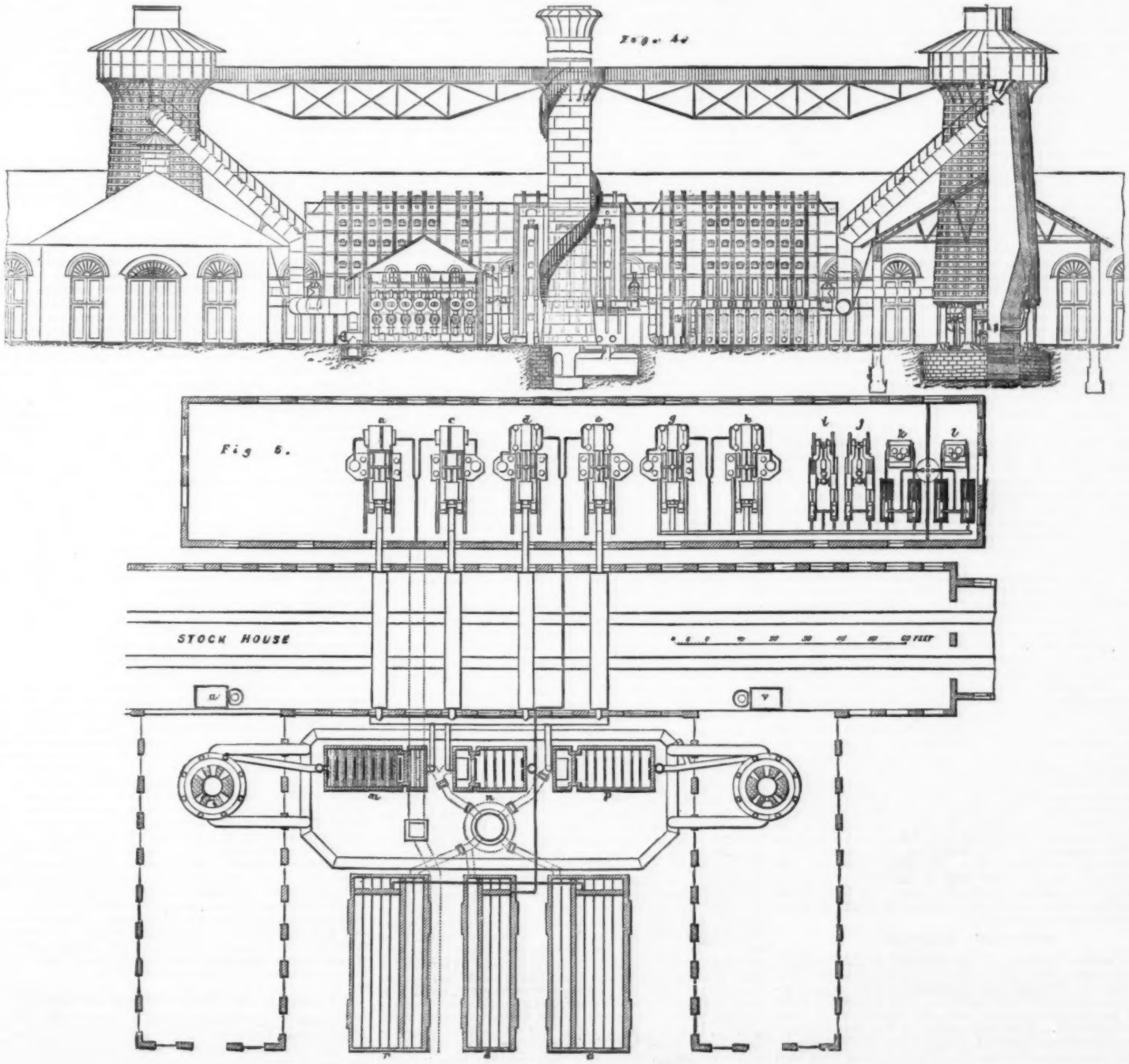
The engines are placed far away from the dust of the furnaces, and are separated by a tight wall from that of the stock house, in order to save the excessive wear which always accompanies dirt. Carrying steam this long distance in 16 in. pipes thoroughly lagged results in very slight condensation and reduction of pressure. The air pipes from the engines to the stoves are made large enough to form the air reservoirs—a convenient and cheap arrangement in every respect.

The boiler and boiler-house are shown in longitudinal section by Fig. 6, and in cross section by Fig. 7, and the boiler-house in side elevation by Fig. 8. The boiler setting is peculiar, and it is perhaps the only one that completely provides for expansion in every direction without subjecting the boiler to injurious strains. Each boiler is suspended by sixteen brackets, and these are upheld, as shown in Figs. 6 and 7, by four equalising beams which rest on two heavy girders extending across the building. The two main batteries *r* and *t*, Fig. 7, contain seven boilers each. The upper shells are 70 ft. long by 40 in. in diameter. The lower shells are 30 in. in diameter. The supplementary battery *s* consists of five boilers.

Each main hot-blast stove has 80 pipes, the supplementary stove has 50. The pipes are 20 ft. high and 8 in. inside diameter. They are made circular in cross-section instead of being flattened, since at a good heat and at the least pressure, often over 10 lb. per inch, necessary for anthracite, they tend to become circular, and hence they last better if so made at first. The general arrangement of the stove and its bracing is shown by Fig. 4 and Fig. 9.

The chimney shown in Fig. 4 is one of unusual size, being 176 ft. high and 11 ft. in diameter, the base being 16 ft. in diameter. The stack is lined with inferior firebrick 9 in. thick, and is cased with a shell of plate iron ½ in. thick at the base of the stack, and ⅜ in. thick in the upper portion.

Those who are familiar with the difficulties of working anthracite furnaces on irregular ores will appreciate the manner in which the Bethlehem furnaces are run, when it is stated that the No. 1 furnace was run seven years without blowing out, and made 70,000 tons of pig on one lining.—*Engineering.*



BLAST FURNACES OF THE BETHLEHEM, PA., IRON WORKS.

[Continued from Supplement No. 92.]

THE BRITISH ASSOCIATION.

GEOGRAPHY.

The address in Section E was delivered by Vice-Admiral Sir Erasmus Ommanney. Ostensibly a general review of the progress of geographical research, it was mainly a résumé of arctic voyages, with which the public are now more or less familiar. We, however, make an abstract of the gallant admiral's remarks on the Nares expedition with the Alert and Discovery. As an arctic voyager he expressed his unqualified approval of the conduct of Captain Nares in his wise decision to return home; nothing could have been gained by remaining out another season, and the able seamanship displayed in effecting the escape from so perilous a position was admirable. Before quitting the glacial regions he would venture to give his opinion with reference to future exploration. By the valuable information brought home by Nares as to the physical conditions of the paleocrystic ice, which he believed to occupy all the circumpolar area within the eighty-third parallel, all ideas of reaching the pole from that direction, or anywhere north of the Parry Group, might be discarded; and he thought this formidable ice would arrest the voyager sooner or later in navigating towards the pole. But, instead of nations racing for the pole, let them accomplish what was practicable. To complete the coast line of North Greenland would be interesting to all geographers—namely, to connect the coast between Beaumont's farthest, and Koldeway's north limit of discovery at Cape Bismarck—and might be accomplished from a winter station on the east coast. A scientific survey of Franz-Josef Land would be of great service to the interests of science. Payer observed a navigable sea from his extreme north position at Cape Fligeley between him and Oscar Land. Research in that direction appeared to hold out a hope of success in finding more land in that region. The Swedes were preparing an expedition to make a passage from Novaya Zembya along the Siberian coast to Behring's Straits. All must, however, admit that England retains the proud distinction of being the foremost nation in polar research; and if Nares did not reach the pole, his voyage had contributed largely to the sum of human knowledge. Admiral Ommanney then referred to the development of ocean telegraphy, and the expedition in the Challenger, by which memorable expedition Dr. Carpenter's views of the vertical circulation of the ocean were, he considered, substantially confirmed. It was found that the old idea of a deep-sea temperature of 39° was an error, which had been caused by the derangement of the readings of the old unguarded thermometers under the pressure of the water of the deep-sea, and that a temperature of 32° prevails at deep ocean bottoms, even at the equator, the cold there being due to a constant overflow of dense water from the polar seas towards the equator. Throughout the long examination of the ocean depths by the Challenger, the conclusion was amply confirmed that there was animal life at all depths. Maritime meteorology, which had resolved itself into a distinct subject of investigation, was being conducted in this country under the direction of Mr. Robert H. Scott, F.R.S., and the Meteorological Committee, and would be productive of useful and practical service in navigation. The President next directed attention to the great continent of Africa. Livingstone's last work of enduring toil was the discovery of the lakes Moero and Banguelo, and following the watercourse of the Lualaba northward to Nyangwé. Upon his death the desire of the public of this country to civilize the African, and to develop the productions of the country, greatly increased. Under Stanley, Gordon, and Cameron, the great achievement had been attained of navigating the three great lakes. To Colonel Gordon was due the honor of placing a steamboat on the Albert Nyanza, completing the work which the gallant Baker, the discoverer of the lake, had so much at heart. Last of all, they must accord a tribute of praise to the young naval officer, Lieutenant Cameron, for his marvelous journey, as being the first European who had ever crossed tropical Africa from the Indian Ocean to the Atlantic, a distance of about 3,000 miles, 1,200 of which was over new ground never before trodden by white man. On this route he defined the parting shed between the basin of the Lualaba and the tributaries of the River Zambesi. Another naval officer, Mr. E. D. Young, had also earned distinction as a traveler by exploring Lake Nyassa, which he found to extend 100 miles further north than Dr. Livingstone had imagined. The most interesting problem now to solve would be to find the head waters of the mighty Congo, and connect it with the Atlantic. He called attention to the international effort initiated last autumn by his Majesty the King of the Belgians, at a congress held in Brussels, for the purpose of organizing means for the systematic and continuous exploration of Africa, and with a view to encourage the interests of all civilized nations in the world in furtherance of such a desirable object. The council of the British Association had issued a circular, showing the course they proposed to take in this matter in connection with the Royal Geographical Society. The President then glanced at explorations recently made in Asia and Madagascar, and to the great achievement of Lesseps in the Suez Canal. It was scarcely creditable to us that more was not known of the New Guinea coasts, so close to our own dominions, but it appeared impossible to establish settlements there. The rapid progress and development of America, and the colonization of Vancouver's Island, the opening up of Japan, and the discovery of a coal-field in China, were also touched on. We might justly feel proud that the verdict of other nations accorded to us pre-eminence in geographical research. It was satisfactory to perceive that geography had become a subject of general interest, and, as a science, was daily progressing, and taking a more elevated position in the political as well as in the commercial world. With a view to give greater encouragement in the study of geography in a more strictly scientific direction, the council of the Royal Geographical Society had provided means for insuring a certain number of lectures during each session from scientists of the highest order. We might hope that our efforts on this occasion might tend to increase that spirit for advancing geographical knowledge which had been so well exemplified in days past by the exploits of Drake, Raleigh, and many other naval worthies.

ECONOMIC SCIENCE.

The address in Section F was delivered by the President, Earl Fortescue, who said: The mere numerical record or collection of bare facts, not marshalled on any system, remained an unfruitful heap until the facts reduced to order could be brought to bear upon the elucidation of some general principle. There was reason to fear that statistics were sought out and adapted to suit a preconceived theory. Another misuse of statistics was that when they were used to test certain capacities and qualifications, work was directed and shaped to meet the statistical test, and the results thus obtained became misleading. Deeper reflection and fuller inquiry had often revealed other truths, which, in many instances, had reversed the conclusions practically to be deduced in the particular case. After some remarks on the teachings of Malthus and Mill, and on the modern phase of the population question, the President said that Mr. Chadwick demonstrated in several of his early writings, and especially in that most remarkable work, the Sanitary Report of 1842, that excessive sickness, with premature disability and mortality in a population, did not (except, of course, in very extreme cases) tend in general to diminish the aggregate number, but only the average efficiency, of the living and the average productiveness of their labor. He showed, with the aid of the comparatively very imperfect statistics then available, that in the unhealthiest districts of the country the proportion of persons incapable of maintaining themselves, of children, of invalids, of the aged (for some of the most remarkable instances of individual longevity were to be found in them), was far larger than in the healthy districts. He showed, comparing the healthiest with the average districts, that the cost of excessive sickness and premature disability and death, including the consequent loss of productive labor, involved throughout the kingdom an annual loss of over £14,000,000, even according to that defective standard—a loss which, he might observe, had gone on uninterruptedly to the present day, since, notwithstanding all our wise sanitary legislation and great expenditure on sanitary works, our annual percentage of excessive mortality throughout the kingdom, resulting from preventible disease, had hardly been appreciably diminished, so largely had population increased during that time in places, and under circumstances, where no commensurate sanitary precautions had been adopted. Indeed, London actually had had its rate of mortality augmented under the costly mismanagement of the Metropolitan Board of Works. Mr. Chadwick further contended that in an energetic and skillful population, freely allowed to obtain what they could get more advantageously from other countries for what they could produce more cheaply at home, the tendency of the demand for labor would be absolutely to outstrip the ordinary growth of population. Accordingly we had seen the population of Lancashire quadrupled since the beginning of the century, and yet wages, far from being lowered, at least doubled during the same period. Dr. Farr, also, in his truly philosophical supplement to the 35th report to the Registrar-General in 1875, showed that as the death-rate rose so did the birth-rate. The President then referred to monopolies, contending that gasworks, waterworks, and railways were truly monopolies, and for the sake of the public ought to be carefully restricted. He concluded by referring to the confusion at present existing in the system of local governing boards, the great increase in their indebtedness, and the "mob of officials" created by them.

RAILWAY BRAKES.

The President of Section G, Mr. E. Woods, C. E., took for the subject of his address the question of railway brakes, and as he was one of the engineers intrusted with the experiments on behalf of the Railway Commissioners, his remarks cannot fail to be interesting. With few exceptions, and up to a comparatively recent period, the companies, said Mr. Woods, had remained content with the brake-appliances which were common 40 years ago. These, no doubt, were sufficient to control the trains in those early days, few as they were in number, and limited in weight and speed. The brakes were applied separately, and by hand-power, always to the tender, and usually to some few of the carriages and to the guards' van or vans, if such accompanied the train. As long ago as 1858 the Board of Trade called the special attention of the Railway Companies to the fact that the amount of brake-power then habitually applied was insufficient to prevent frequent accidents occurring from collisions, many of which they considered might be averted. Particular reference was made to two systems which had come into daily use on the East Lancashire and Lancashire and Yorkshire Railways—namely, the brakes of Newall and of Fay—by means of which trains of 90 to 100 tons weight, running 50 miles an hour, could be effectually controlled by driver or guard, even when proceeding down steep inclines, and brought up within a moderate distance. It was certainly matter for surprise, seeing the advantage of continuous brakes, that the railway companies should have so long tolerated the old system, and been so slow to adopt a method which, instead of being dependent for its due action on the attention of several persons, was effectually placed under the control of one. This lethargy prevailed, too, throughout a period when increased speed had come to be demanded, when augmenting traffic required heavier trains, and when, consequently, more ponderous and powerful engines had to be used—circumstances which ought to have induced the companies to effect simultaneously a readjustment of their brake appliances. After the year 1830 many attempts were made to supersede the ordinary type of brake, some of the brakes introduced being self acting and put into operation by the momentum of the train, while others acted as sledges or shoes. None, however, proved successful. The continuous brakes of Newall and Fay simply involved a wider distribution of power over the different vehicles of the train, and gave the means of applying that power by one, or, at most, two attendants. It was in that direction that the ingenuity of inventors had recently been turned, and there were now several systems of continuous brakes in successful working on the leading railways, each claiming some special advantages over its rivals, whether as more simple in construction, less expensive in application, or effecting more complete control of the train. The President then described the conditions of the trials of the brakes on the Nottingham and Lincoln branch line, and stated that it was then demonstrated that the friction of a complete train, in which the weight of the engine and tender constituted, say, one-fourth of the gross weight, inclusive of the atmospheric resistance it encountered in its course, was ·42 per cent., or about 9¼ lbs. per ton. This result confirmed what long experience had led them to anticipate. It was discovered further that, on a level line, a train running at the rate of 45 miles an hour could be stopped by hand brakes within 1,000 yards, or, if at the rate of 60 miles, within 1,700 yards. The necessity for some greater control over fast passenger trains was thus rendered obvious. Through the want of a larger amount of brake power much time was lost on a journey when the stoppages were frequent, the drivers being compelled to slacken speed at long distances from the stopping places. It seemed, indeed, scarcely to admit of the question that a system which was deemed necessary in special cases might be advantageously applicable in all cases; that to render the control of a train complete, brakes should be applied to all, or nearly all, the wheels; and that, at least, the driver, if not the guards, should possess the power of promptly bringing the whole into action. The truth of the principle was not very generally admitted by the leading companies, some of whom had already adopted continuous brakes, while others were preparing to do so. Rather startling disparities were disclosed during the experiments. Some of the disparities were attributable to the contrivances being of comparatively recent origin; but others were clearly owing to the principle upon which the action of the brake was founded, as between the air pressure and the vacuum brakes there was a loss of 6¼ seconds, which in a train running 60 miles an hour was equivalent to 180 yards additional space traversed in the stop. Three of the experiments involved the application of all available power for stopping. Sand was used, and was found to add sensibly to the stopping power. On an average it made an addition of 1·30 per cent. to the retarding force otherwise brought into play. The trials proved in a very striking manner the great advantage of continuous brakes, for even in their least effective form they afforded more than double the stopping power of the usual hand brakes, while in their most effective form the power was quadrupled. He was of opinion that no system could be considered satisfactory which did not produce a retarding power of at least 8 to 10 per cent. of the entire weight of the train; in other words, a power by which fast trains could be stopped in from one-third to one-fourth less time than at present. The unpleasant sensation often experienced during quick stoppages was produced by intermittant and fitful action. After the brakes had been made to bite the wheels their hold became relaxed, a slip took place, followed by successive bites and slips, the latter giving rise to sudden acceleration of speed. The action of a perfect brake should exactly resemble that which gravity would cause if an ascending incline of uniform gradient could be suddenly placed in front of the train to prevent its motion. Under such conditions no inconvenience or danger need be apprehended from the stoppage being accomplished within even a shorter distance than any that was effected during the experiments. A valuable addition of power under the immediate control of the driver would be afforded by the fitting of brakes to the engine, and he was glad to find that the recommendation of the Royal Commissioners in this respect had met with prompt attention at the hands of the railway companies. The question of the best material for brake blocks had of late received a good deal of consideration, and it would seem that cast iron, and even steel, was fast superseding wood. It generally happened that wheels did not become skidded until the speed of the train had been materially reduced. It seemed desirable, therefore, that for ordinary stops the brake pressure should be applied so as to act just short of skidding the wheels, the full skidding power being only used in cases of imminent danger. The general adoption of an effective system of continuous brakes on carriages which had to run from one line to another would be productive of much advantage, for then, in breaking-up and re-making a train at any junction station, the carriages would be found ready-fitted with the requisite appliances for working. If allied companies could only agree to adopt the same system, brake improvements would proceed with far greater rapidity than at present, and public convenience would thereby be promoted. The time had arrived when each system should be scrutinized and tested in the most complete manner, but when the companies should clearly set before themselves the conditions which a good continuous brake ought to supply. The President concluded by recapitulating the points of a good brake.

REPORT ON UNDERGROUND TEMPERATURE.

Professor Everett read the report of the Committee on Underground Temperature. The observations conducted under the auspices of this committee were intended to determine the rate at which temperature increases as we go deeper into the earth. They were sometimes made by lowering self-registering thermometers into deep bores, or artesian wells, sometimes by placing thermometers in holes bored in mining galleries, leaving the thermometers there for a considerable time, and then taking them out and reading them. The contributions the committee had to make this year were from three different places. Observations on a very elaborate scale had been received from the important mining districts of Schemnitz in Hungary. A request for observations was sent in 1873 to the Imperial School of Forests and Mines, and a committee was formed. Dr. Otto Schwartz, Professor of Physics and Mathematics, undertook the leading part in the work of the committee. His observations gave the following results: No. 1 shaft, an increase of 1° Fahrenheit for every 89·5 ft.; No. 2, 1 for 72 ft.; No. 3, 1 for 64·2 ft.; No. 4, 1 for 55·2 ft.; No 5, 1 for 93.2 ft., showing a mean increase of 1° for every 75·5 ft. The best mode of combining these results was to compare the sum of the depths with the sum of the increments of temperature. They thus had a total increase of 38·3° C. in 1,587 metres, at the rate of 1° C. in 41·4 metres, or 1° F. in 75·5 ft. Comparing the deepest with the shallowest temperatures (as a check on the assumed surface temperature) it was found that the mean increase was 1° in 72·5 ft. The mean of the two results was 1° in 74 ft. The rocks consisted for the most part of trachyte and greenstone. Thanks were due to M. Antoine Peck, ministerial councilor and director of the mines, and to Herr Ed. Pörchl, director of the school, for energetic co-operation in this extensive and valuable series of observations. The next series of observations were made by Mr. Matthew Heckels, manager of Boldon Colliery, near Newcastle, in holes bored upwards to a distance of 10 ft. from some of the deepest seams. The mine was perfectly dry, and where the observations were made free from currents of air. The result of these observations was an increase of 30° F. for a depth of 1,514 ft., at the rate of 1° in 49 ft. The conditions under which they were made rendered them extremely valuable. Observations had been also received for the first time from India. They were taken by Mr. H. B. Mendicott, M.A., of the Geological Survey, in bores made in search of coal, at places called Khappa, Manegaon, and Moran, and have been published by him in the "Records of the Geological Survey of India, Vol. X." Only the Observations at Manegaon were entirely satisfactory. It was apparent from these that the influence of excessive summer heat reached to a considerable depth. The increase from 60 ft. downwards was remarkably uniform, and the whole increase from this depth to the lowest reached was 3·7°: at the rate of 1° Fahrenheit for 68 ft.

THERMAL CONDUCTIVITIES OF ROCKS.

Professor A. S. Herschel, M. A., F. R. A. S., read the fourth annual report (by himself and Mr. G. A. Lebour) on the thermal conductivities of rocks, which pointed out that the work during the past year consisted in the verification of former results, and in the extension of the inquiry to other rocks. The same apparatus was used as before, with the

substitution of iridio-platinum for iron. In the whole functions of the thermopile, fluorspar was again found to have the highest conductivity, and sand the lowest of the rocks tried this year. Fluor spar, quartz, and quartzite formed a natural group, with high conductivities. Granites—red and grey from various localities—came next; micaceous sandstone, and mica-schist next; marbles and dolomites following, with all the more compact limestones. Traps came next, then the altered shale, chald (white and grey), and firestone, shales and dry clay, and sand, which was markedly the worst conductor. Clay with a quarter of its weight of water became as good in condition as altered shale, while sand with half its weight of water became nearly as good as quartzite. Plate glass had about the same conductivity as dry clay.

Mr. Pengelly and Mr. Sorby called attention to the importance of guarding against the influence of convection currents in studying the conductivity of rocks. Mr. Williams stated that fluor spar differed in different directions as to its power of conducting electricity; and thought that probably the same would occur with respect to thermal conductivity. Mr. D. Burns and Mr. Baldwin Latham also spoke, the latter referring to the temperature in the chalk wells at Croydon. Mr. Lebour pointed out the connection which existed between rock-conductivities and discrepancies found in temperature observations in wet and dry bore-holes; and invited members to cöoperate with the committee by sending them specimens of various rocks, sufficiently large to permit of discs, 5 in. in diameter and at least ¼ in. thick, being cut from them.

THE COLOR OF ANIMALS.

MR. W. ACKROYD read a paper on the colors of animals. The burden of his essay, which was well weighted with statistics deduced from careful experiment, was an endeavor to prove that colors are assigned to animals in proportion to their vigor. Thus, among birds it would be found that the males were brighter and more gaudy than the females. Among beasts and fishes analogous coloric distinctions were to be observed. He argued that colors are distributed according their power of heat conductivity. Many instances were adduced in the paper to prove that the more remote from the center of the blood circulation the covering of an animal may be, the more its hue tends to heat absorption. Professor Newton inclined to the opinion that the coloration of animals depends rather on environment than on vigor. It seemed almost whimsical the way in which colors were sometimes distributed. For instance, there was a breed of birds in Canada and the United States resembling the starlings of England, the male of which was a beautiful black, with flame-colored marks on its wings, and the female of a miserably dingy hue. The very same species he had found in Cuba, and there both male and female were of the same hues. Mr. Forbes spoke of a breed of parrots, the male of which is green, like the foliage among which it lives, while the female is richly variegated in plumage.

CHEMICAL CONSTITUTION OF THE SOLAR SYSTEM.

DR. GLADSTONE read a paper on "Some Points Connected with the Solar System." He thought he might assume that the discoveries of spectroscopists, and the general advance of knowledge on astronomical matters, had greatly confirmed the nebular theory of the formation of worlds. Suppose, then, a great nebulous mass made up of a great many different chemical elements gradually condensing towards the center. First of all, the cooling took place in the outer portion of the nebulæ, but as this condensed and the whole mass cooled, the less volatile substances would condense at a short distance from the center, while the more volatile extended further away from the center. Thus they had a rough arrangement of the elements—the denser towards the center, the lighter outside. He said "roughly" because all who knew anything of fractional distillation knew it was impossible to entirely separate gases from one another by these means. Many years ago Professor Johnstone Storey, in a paper connected with the Royal Society, foretold some of the more recent discoveries in this branch of science—viz., that these gases would arrange themselves according to their several densities, the most dense converging towards the center. But this also only took place "roughly," because there was a constant diffusion going on; particles of the more dense matter constantly flying off into the distant parts of the system. Still, on the whole the operation was that the higher gases ranged themselves on the outside, while the denser ranged themselves towards the middle. What he had been describing was what exactly took place in the sun. They found on the outside an immense atmosphere of hydrogen, the most volatile of the gases, then lower down sodium, iron, and magnesium, condensing into clouds; the center being composed of they knew not what. The particles of denser matter which escaped into the outer regions of the nebular mass gradually condensed, collecting around them the lighter, and became planets, comets, and meteors. What were the elements of which these outer bodies were composed? If the nebular theory was correct, the planets ought to contain the more volatile gases in large proportion, and the less volatile or denser in small. Was this so? It was pointed out that the average density of the plentiful non-metallic elements was 19·8 against 63 of the not plentiful; and the same proportion was observed in the metals, thus: Plentiful, 37·8; common, 104·5; rare, 106·7; very rare, 122·9. They found, therefore, that this grouping of the elements was exactly what one would anticipate would take place on the nebulitic hypothesis of the origin of the solar system. In the composition of the meteoric stones this was borne out still more strikingly. Dr. Gladstone produced several specimens of meteors. Having pointed out certain circumstances tending to interfere with the rule he had laid down, which should make them cautious in drawing any negative conclusions, he directed his attention to the constitution of the comets. Huggins had shown that comets exhibited their own light, and that light examined in the spectroscope showed bands, which suggested the existence of carbon in them. It had been suggested that the comets' heads might be made up of little pieces of carbon, like diamonds, which, colliding, became incandescent, and threw out a brilliant light. Thus it was not the twinkling stars that were the "diamonds in the sky," but the heads of comets. He had tried whether real carbon when volatilized would give this band spectrum or not. The result of his experiments satisfied him that such bands were produced by carbon, as they saw in the spectrum of the comet. Therefore, it was quite possible that comets might consist of pieces of carbon, such as one of the meteorites he had produced; and they had reason to suppose that the meteorites themselves were the tail of the comet, and that the "wish" of the tail against our atmosphere brought them to the earth.

Professor McLeod pointed out reasons for altering Dr. Gladstone's figures more in favor of his theory. Mr. S. P. Thompson pointed out that in the case of the earth carbon was always combined with oxygen. It was found that in the meteors which had fallen the carbon had also been combined with oxygen, an essential to animal and vegetable life. How this bore on Sir W. Thomson's idea as to meteoric life was obvious. Captain Abney said that Mr. Lockyer in a recent lecture had drawn attention to the smaller specific gravity of Neptune, and the more distant planets as proofs of the nebular theory. Dr. Gladstone, replying to a question, said it might be possible to make out what was in the atmosphere of some of the distant planets, but, unfortunately, their spectra, peculiar as they were, were at present unintelligible, whether or not meteorites and comets originally formed part of the same nebulæ as the solar system: at any rate, they had come into the system, and if they came from outside it his case was strengthened.

THE MOVEMENTS OF WATER IN PLANTS.

PROFESSOR MCNAB, in a paper on this subject, said that experiments made by him, the results of which were published some time since, showed that the rapidity of the ascent of water in the xylem of the stem of a plant was nearly 40 inches an hour. Since the publication of the result Professor Pfitzer, of Heidelberg, has made many experiments on the movement of water in plants. By him three methods were adopted. He first experimented by observing how soon leaves which had become flaccid from want of water regained their normal position when fed with the liquid. Pfitzer's second experiment was simply a repetition of that initiated by Prof. McNab—viz., he used lithium, which could be detected with the spectroscope, instead of water. His third series of experiments combined both the other methods, and as a result of them it was found that in the sunflower the velocity of the ascent of water in the xylem was nearly 22 metres per hour—that is, one-third of a metre, or 13 inches per minute. Later on, however, Prof. Pfitzer adopted a new method, suggested by Prof. Koehne. He substituted a solution of indigo and carmine, such as is extensively used by microscopists, for water and lithium, and the results obtained by means of it corresponded precisely with those recorded by Dr. McNab, whose method of experimenting was adhered to. An important source of possible error in conducting these experiments has, however, been pointed out by Prof. Koehne, who has shown that the air or gases in the vessels of the wood of transpiring shoots are in a state of diminished tension. Shoots cut under mercury in a few minutes exhibit a rise of mercury in the stem of from 20 to 38 centimetres. In the sunflower the tension of the air in the vessels equals 46 centimetres of mercury. This rise of mercury or other fluids in the vessels, due to diminished tension, Prof. McNab styles the abnormal current, in contradistinction to the normal current through the xylem. If the abnormal current were more rapid than the normal, experimenters might be led into grave errors, but Prof. McNab showed that there was demonstrative evidence that this condition does not exist.

LIFE-HISTORY OF SIMPLEST ORGANISMS.

THE Rev. W. H. Dallinger delivered an interesting lecture on "Researches on the Life-History of the Simplest Organisms." The lecturer stated that he had worked out the life-histories of six monads, and then proceeded to give the results of numerous experiments in connection with the same. Motion was, perhaps, nowhere so universal as in the most minute forms of life, and here it was that we often found movements of the most graceful kind. It had not been made quite certain that the degrees of ease and force of motion of these animals depended upon the number of their flagella, which, so far as investigation had yet gone, ranged from one to four. With regard to the most minute forms of life, the lecturer said that the study of their life-histories showed that these forms were perfectly complete and definite; there was no mutation or anything unnatural. The results of the lecturer's experiments with certain life germs showed that when ordinary air was charged with given germs any nutritive fluid receiving these germs would produce monads, while when the air was kept perfectly pure the same fluid would not produce a single monad. With the air at a temperature of 310° Fahrenheit and charged with germs, the fluid produced no monads. As to the theory of the "survival of the fittest," the rev. gentleman stated that he was a perfect convert to it. At a temperature of 45° the six monads with which he had been experimenting were found to live and flourish, and they could bear a sudden increase of temperature up to 60° without exhibiting any signs of inconvenience; but if, upon reaching this point, the temperature was suddenly increased by 5°, the monads showed a a faintness. The temperature might, however, by a slow process be increased to 127°, in which the monads would live, and multiply even more rapidly than in a temperature of 45°. The results of similar experiments also seemed to show that it took a much longer time to produce a modification in the ovum than to produce a modification in the parent. At the conclusion of the lecture, Professor Macalister remarked that the questions raised by the lecturer were simply of incalculable importance.

TIDAL INVESTIGATIONS.—THE ADMIRALTY TABLES.

SIR W. THOMSON read a statement of investigations made by Captain Evans, the Admiralty Hydrographer, in reference to the tides of Port Louis (Mauritius), and Freemantle (Australia). He prefaced the statement by saying that the investigation had been undertaken in consequence of the recent government grant for scientific investigations. A sum of £200 had been voted from this grant on the urgent representations of Captain Evans and himself, for the purpose of investigating the tides of the northern hemispheres, and making certain definite advances in the investigation of the tides in other parts of the world, particularly in the Mediterranean. The first proceeds of the work done for this grant was the paper he had now the privilege of laying before the section. Their observations showed that there was a very near approach to equality between the solar-diurnal tide and the lunar-diurnal tide. The diurnal tides at Liverpool and Freemantle were about the same, but the semi-diurnal tide was about 200 times as much at Liverpool as at Freemantle. He hoped that as they went on with these investigations they would be able not only to work out interesting scientific results, but to work out a practical way of giving tidal information in a form in which it would be useful to sailors—a desideratum which had not yet been obtained. Hitherto the theory of the Hydrographical Office was that the information given in the Admiralty tide-tables was sufficient for the practical purposes of navigation; and it was on that theory that Mr. Lowe, when Chancellor of the Exchequer, refused the application of the British Association for assistance in the matter. The fact was that the Admiralty tables did not give all that was necessary for the purposes of navigation; so that whatever good reason Mr. Lowe might have had for refusing the grant on other grounds, the reason he gave was a bad one. However, the money had now been obtained, though in an indirect way. He hoped that the working of this grant of £100,000 for scientific purposes, about which there had been so many discussions, would disprove all the anticipations of its enemies, and more than fulfill all the aspirations of those who had looked forward to it as a great boon to science, likely to produce results beneficial to the whole world.

THE PEARLY NAUTILUS.

DR. G. BENNETT, F.L.S., in the course of a paper on the Pearly Nautilus, observed that the idea that nautilus and spirula are deep-water forms is fallacious, for though the nautilus pompilius has rarely been met with, the shells are often found on beaches in the Indian Ocean and South Pacific, when he said he was not aware of any deep-water mollusc ever having been cast. On the 24th of July, 1874, however, the Challenger exploring party netted a nautilus in about 320 fathoms of water off Matuka Island, and for some time kept it alive in a tub to observe its habits. It propelled itself after the manner of cephalopods, "backwards," and each pair of its tentacles was found to have a definite and divergent direction. The great depth at which the Challenger's specimen was captured was so opposed to experience that Dr. Bennett felt inclined to believe it was netted by the trawl as it passed near the reef, or as it was floating at a slight depth. It was noticed that the Challenger nautilus attained locomotion by ejecting water after the manner of the cuttle fish. The paper described the air chambers, by means of which the fish descends or rises at will in the water, and the muscular funnel, by the use of which it propels itself in any direction, regardless of currents.

EXCLUDING GERMS FROM OPERATING ROOMS.

MR. WILLIAM THOMSON, F.R.S.E., F.C.S., gave a brief discourse upon a method of excluding the germs of the air from a room or rooms used for surgical operations. He said he had experimented upon flour pastes, with a view to study the development of different fungi, and found that, when the germs of fungus in the paste had been destroyed by heat, if the wide opening of a vessel containing the pastes were covered by a thin layer of cotton wool, placed between two pieces of cloth, that the spores which floated everywhere in the atmosphere would be prevented from falling and growing on the paste; but if flour paste were not thus protected, fungus would develop all over the surface in the space of a few days. He proposed to form a long room, or series of rooms, to be used for making surgical operations, which should have a gentle current of filtered air passed through it by means of a fan; thus when the door of the room was opened a gentle current of pure air would pass outwards, and prevent any spores from entering. He referred to gangrene in hospitals, and said that if the walls of such rooms were heated with a long row of gas jets to destroy any germs adhering to the walls, whilst a current of pure or filtered air was passed through it, that all objectionable spores would be removed, and that if operations were made in such chambers, little fear of blood-poisoning would result. He exhibited a model room, 36 in. long, 18 in. broad, and 22 in. high, arranged with an appliance for passing air through it. In this he had preserved flour paste free from fungus life until it had dried up to a hard mass, whilst the same kind of paste, placed in another vessel outside the room, was completely covered with fungus.

ACTION OF OILS ON COPPER.

A PAPER on "The Action of Various Fatty Oils upon Copper," by William H. Watson, F. C. S., gave in detail a number of experiments, showing the extent to which ten different oils act upon copper. The result of the experiment seemed to show that paraffin and castor have the least action upon copper, and that the action of sperm oil and seal oil is slight. Linseed, almond, olive, sesame, neatsfoot, and colza produced considerable action upon copper, linseed oil being most active. The author concluded from his experiment that the comparative action of different oils cannot be correctly decided in all cases simply from the appearances of the oils after exposure to copper plates, though minute quantities of the metal might be easily detected in most oils from the color which is produced by such exposure. An associate expressed gratification at the results of Mr. Watson's experiments, as they confirmed the results of his own. He felt now that he should be quite competent, with the aid of what he had now learnt, to do that which he had long been attempting—namely, to bring lubricating oils to a higher state of perfection.

TURNING OF SCREW STEAMERS.

PROFESSOR O. REYNOLDS presented the report of the committee appointed to consider what effect reversing the screw had on the steering of a steamer under full way. Since the last meeting of the Association the committee had carried out further experiments, and the results now obtained showed that the larger the ship the more important the effect of reversing the screw became. In answer to the request of the committee, the Admiralty had made a trial with H. M. steamship Speedy, but the conditions under which it was conducted precluded the possibility of more light being thrown upon the subject. The greatest speed was 5 knots, and the effect of the rudder with the screw reversed was so small that the Speedy (!) in most instances turned her forehead end into the wind. The Admiralty had been urged to have experiments made with larger and more powerful ships, but had as yet not assented. The committee forwarded copies of their last year's report to the Admiralty, the Board of Trade, the Trinity House and other corporations, but no intimation had been received as to any action being taken upon it. The report was discussed at the Conference of the Association for the Reform and Codification of the Law of Nations last year at Bremen, where a resolution was agreed to declaring that the existing international rules for preventing collisions at sea were not satisfactory, and it was desirable the government of maritime states should take counsel together with a view to amend the rules and adapt them more carefully to the novel exigencies of steam navigation. This showed that the subject had already attracted considerable attention, and it was important to notice that the conclusions of the committee had not yet in the smallest degree been controverted. Numerous collisions had happened during the year, which, to judge from the law reports, might in

many instances have been avoided had the effect of reversing the screw been known and acted upon; but it did not appear as if a consideration of this had influenced any of the judgments given. Such was the faith of the English people in the practical that it was very difficult indeed for them to believe that a few landsmen, calling themselves scientific, could teach sailors how to steer ships. So strong was the feeling that it was to collisions they must look in the hope of preventing collisions. This sounded like a bull, but it was perfectly true, for nothing but disasters would awake our rulers to the idea that something was wrong. Fortunately or unfortunately, such disasters were not wanting. There was the case of the Ville du Havre and the Loch Earn, in which the collision was undoubtedly due to the steamer having turned in the opposite direction to that intended. These and other disasters furnish evidence enough of the mistakes which had been perpetrated, and of the importance as well as the truth of the results the committee had established. He fancied that the ignorance which existed was due to the fact that few seamen had turned a ship under full way with the screw reversed, and contented themselves by arguing as to what must happen in such a case from their experience in manœuvering the ships when moving slowly. Of such manœuvers they have had abundance, but as soon as they got beyond their experience, they adopted the seemingly obvious but entirely erroneous opinion that the way of the ship would cause the rudder to act as if she was going ahead in spite of the screw being reversed. Mr. William Froude thought the question which Professor Reynolds had so ably dealt with of immense importance, and deserving minute consideration. Having himself had some experience of small steam launches, he had been surprised at the effect produced by the working of the screw, so that he concurred with the conclusion to which Professor Reynolds individually, and the committee collectively, had arrived. Sir William Thomson urged that the committee should be re-appointed, so that the Admiralty might have another opportunity of confirming or refuting the conclusions. This was undoubtedly nothing less than a national question, for the conflict now going on between Russia and Turkey proved that skill in manœuvering was of vital importance in torpedo warfare.

THE RESISTANCE OF SHIPS.

Mr. William Froude, F.R.S., read an interesting paper, describing the effect produced on the resistance to a ship's motion by the lengthening or shortening of the flat middle body between the bow and stern. The results were based upon experiments made with models having the same ends, but different lengths of parallel body inserted amidships. By separating the effect of the fractional skin resistance, which was proportional to the wetted surface, he proved that the increase or diminution of the power required to propel a ship, in consequence of the alteration of the length of the parallel body, depended very largely on the coincidence, or want of coincidence, of the wave crests traveling alongside the ship with the points at which the reduction of breadth by the fine lines began. When this diminution coincided with the wave-crest there was no loss, but rather a gain of speed; while, when it coincided with a wave hollow, the loss of speed, or increase of resistance, was considerable.

LUMINOUS METEORS.

Mr. J. Glaisher read the report of the committee on "Luminous Meteors," which continued the record of a year of very active research, though the principal object the committee had in view—that of furnishing observers with a *résumé* of star showers and meteor systems, occasional and periodical, during recent years, such as would serve as a guide for the future—had to be postponed. The autumn and winter months were marked by numerous large fireballs in England and abroad; and two aërolites had fallen, one in America and one near the town of Constantina, in Algeria. A magnificent meteor was seen in the United States in December last, from which one of these aerolites was projected. An equally splendid aerolite passed over Cape Colony on the 16th of March last, with loud explosions; but no aerolites were known to have fallen from it in its flight. Among the ten brilliant fireballs might be enumerated those seen in England, of which one, at least—that which burst over the Channel on September 24th—was of the most unusual brightness. The other conspicuous meteors noticed since the previous report took place on November 8th and March 17th, as well as on April 6th. This last meteor was exceedingly brilliant over Cork and Waterford, in Ireland. A remarkable success in the work of calculating the real paths and velocities had been made known in Germany, where Dr. Von Niessel had shown that two large detonating meteors which burst with loud explosions over Bavaria and Bohemia, April 9th, 1874, and April 10th, 1876, were not only connected together in date and in the place of their appearance, but also astronomically in the system to which they belonged, as they were both found in their origins, or the direction of their course, to have a common radiant point. The committee had been engaged in the continued examination and comparison of star showers, and in this inquiry an immense labor had been performed for the past twelve months by Mr. W. F. Denning, of Bristol. There had been no marked star showers for one or two years; but some examples of frequency on certain nights had occurred in America on the night of 18th–19th October last, and on 23d August and 13th September in England. The past year had added fully 30 or 40 radiant points to those recorded before. In continuation the report gave descriptions of several brilliant meteors observed in 1876 and their rates of velocity, which varied from 19½ to 40 miles per second. On the subject of meteoric irons, statistics were given of the fallen meteors found in the Mexican district, which amounted in total weight to over 15,000 kilogrammes. The report concluded with an account of a meteoric fall on April 26th last year in Shropshire. After a heavy explosion like that of artillery, which was audible for many miles, a meteorite was found in a field near the town of Wellington. When discovered it was still warm, and weighed 7¾ lbs. It had been exhibited at a bazaar at Wolverhampton, and since then the Duke of Cleveland had presented it to the British Association. This was only the seventh of which the fall had been witnessed. The fall of only eight aerolites had been recorded in England, of which the last occurred in 1844. Professor Herschel remarked that only 4 or 5 aerolites fell on the earth in a year, and it was, therefore, no matter for surprise that so few were known to have fallen in England. Great interest attached to accurate observations of the course of the meteors, for the determination of a meteor's path ranked in astronomy with the discovery of a planet.

REMOVAL OF EDDYSTONE LIGHTHOUSE.

Mr. Isaac Douglass, of the Trinity House, in the course of a paper on the Eddystone Lighthouse, stated that Smeaton's great work was not destined to last much longer. Owing to very considerable tremor which occurred with each wave-stroke during heavy storms from westward, fears had been entertained for the safety of the structure, particularly as sea-water had frequently been driven through the the joints of the masonry. The upper part was strengthened in 1839 and 1865 with internal wrought-iron bars extending from the lantern floor downwards to the solid portion of the tower. On the last occasion he found that the chief mischief arose from the upward stroke of the sea at the cornice; but repairs were effected and further leakage prevented. The tower was still sound, but unfortunately the rock on which the lighthouse was built had been seriously undermined and weakened by the sea. This appeared to be chiefly due to the incessant straining of the rock by the heavy sea strokes on the tower. It had, therefore, been determined to erect another lighthouse of larger dimensions, for which a good foundation had been discovered about 120 ft. off. The elevation of a light for a range of 19 nautical miles was very desirable, so that it might be extended more towards the Channel Rock, and made to overlap the range of the neighboring Lizard lights to the westward. Unfortunately the sea rose during stormy weather considerably above the top of the lantern, thus often eclipsing the light, and altering its distinctive character. This was a matter of much greater importance in the present day than it was at the time of the erection of the structure, from the enormous increase in the number of shipping and the additional lighthouses which had been established, each having a distinctive character. The power of a light in so important a position ought to be raised to the first class; but the capacity of the present tower was insufficient for this as well as for the provision of a first-class fog signal. Telegraphic communication between rock lighthouses and light vessels and the shore, for the purpose of reporting casualties at sea, was very desirable, but the difficulties which presented themselves appeared at present too considerable to justify the necessary outlay for construction and maintenance. Four lightkeepers were attached to the Eddystone, three being constantly on the spot and one on shore in rotation. They were relieved from Plymouth monthly by a steam vessel. The average annual cost of maintaining the lighthouse was about £585. In conclusion, he could not help expressing a hope that if Smeaton's structure had to be taken down, as doubtless it would be after the erection of the proposed new lighthouse, the nation would consider it as worthy of a site on English soil as Cleopatra's Needle. The President sincerely regretted to learn that the removal of the existing lighthouse had been found to be necessary. He hoped it would have endured for all time; but he trusted that the erection of the new structure, which would undoubtedly be attended with some difficulty, would be successfully accomplished.

NEW DOUBLE CURRENT TELEGRAPH KEY.

By P. Trimmer, of the Persian Gulf Telegraph.

Fig. 1 gives an elevation, and Fig. 2 a plan of the connections of this key.

In Fig. 1, K is an ordinary Morse key. I is a brass beam, the two halves of which are insulated from each other at A. This beam works on an axle (shown by the dotted lines) beneath K, from which it is insulated, and plays between the back and front stops *b b'* and *f f'*; it is maintained in whatever position it may be last thrown by the action of K, by the rollers *r* and *r'*. These two rollers work on springs which are so adjusted that when the beam L is in the position of rest, as shewn in Fig. 1, *r* tends to press it downwards, and *r'* upwards. This order of things is reversed when K is depressed, as *r'* then presses L downwards and *r*

Fig. 1.

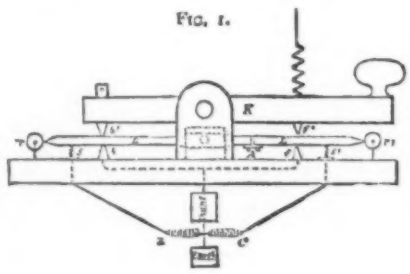
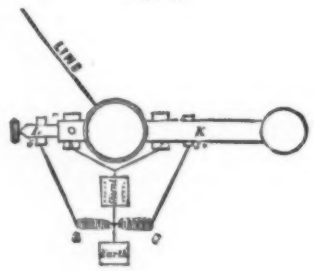


Fig. 2.



presses it upwards. *s* and *s'* are two weak spiral springs by means of which the negative and positive poles of two batteries are maintained in connection with the back and front halves of L respectively. They exercise no influence over the movements of L.

The back and front stops *b* and *f* are permanently in connection, and are to earth through the adjustable resistance marked "Shunt."

The action of the key is as follows:—Fig. 1 shews the key at rest. The switch (not shown in the diagram) being turned to "send," the negative current passes on to the beam L at *s*, and at the stop *b* it divides between the shunt and line; if now K be depressed, L does not follow its movements immediately, being held in position by the spring *s*, but finally it is struck against by *f'*, at which moment the full positive current passes to line, and then L being pressed down until the stop *f* is reached, the shunt comes into play, carrying off a portion of the currentr The negative half of L has at the same time been raised from contact with the back stop *b*, and now occupies the same position with respect to *b* and *b'* as the positive half had previously occupied with regard to *f* and *f'*—viz., touching neither. If now K is allowed to fall back, similar movements take place; first, the full negative current is sent to line at the moment L is struck, which continues until the position of rest is regained, and then the reduced current flows. This arrangement has been worked satisfactorily through 500 miles of cable from Kurrachee to Jask, but from the incomplete nature of the apparatus no reliable comparison as regards speed with the ordinary "permanent" current keys have been obtained.—*Telegraphic Journal.*

ELECTRIC SIGNAL FOR DIVERS.

We subjoin an illustration of a neat arrangement of electric signalling apparatus, designed by Mr. Protheroe, for the use of divers, and patented by him. The invention relates to the means provided to enable the diver to transmit signals through insulated wires imbedded in the ordinary "life line" to a telegraph instrument at the surface, this instrument being of any kind which may be considered most suitable. The fact of the insulated wires being imbedded in the life line dispenses with any extra ropes, while it also leaves the life line free to be used for signalling in the ordinary way if by way of any mischance anything should go wrong with the electrical apparatus.

Referring to our engraving, A is a portion of the diver's life line extending to the vessel above, having enclosed in it, or entwined with it, two insulating conducting wires B and C. These wires terminate in springs D and E, having on them contact faces *d* and *e*, which may be platinized in the usual manner. The ends of the springs D and E engage in a recess in a sliding piece of vulcanite or other non-conducting material F, both ends of which project through the sides of a tube G, in which the spring contacts are enclosed.

Over the tube G is fixed an external tube H of caoutchouc or other flexible waterproof fabric, which covers the ends of the sliding piece F. In the ordinary or normal position of the springs the two contact faces *d* and *e* remain apart, so that no electricity can pass from one of the two wires B and C to the other. But when the diver, by pressing with his thumb on either of the projecting ends of the slide F, pushes either of the springs D and E toward the other, then the two faces *d* and *e* are brought into contact, and an electrical circuit through the wires B and C is completed. By the pressure of the water the outer tube H will be more or less collapsed, but as the pressure acts equally on both ends of the slide F no contact will be made except when it is pressed in either direction by hand. By maintaining contact for a shorter or longer time signals of the ordinary Morse character can be readily transmitted. The ring at the lower end of the apparatus is secured to the diver's waist by a belt or cord. Intelligent communication from an unencumbered diver necessarily facilitates any submarine undertaking, as in most cases where force is required it can be applied from above under the direction of the diver from below. The safety of the diver is also more assured in intricate positions, where by the old method his signals would be indistinct.—*Engineering.*

ELECTRICAL SMOKE FIGURES.

When frictional electricity is caused to act on quiet smoke surfaces, it produces (according to Prof. Antolik, who has recently made observations on the subject) a number of very curious and pretty phenomena.

To produce the smoke surfaces tobacco was used, mixed with a little sugar, and the mixture burnt in an iron pipe surrounded with cold water. By means of a bellows, with caoutchouc tube, the burning was slowly maintained; the smoke was conducted through a caoutchouc tube to a second cooling apparatus, thence through a glass tube and paper funnel, finally streaming out on a smooth black table, and expanding in a circular surface. If the smoke be not properly cooled it forms irregular waves on the table, which are unsuitable for the experiment.

If, now, a Leyden jar, with about 500 sq. ctm., internal coating, and charged with positive electricity, be brought to about one metre above the smoke surface, there appear in the whole of the latter for a moment, proceeding outwards from a central point of action, sharply defined cloudlets of roundish and elliptical form. The entire smoke-surface divides into numerous concentric surfaces, which appear to be as numerously broken, though radially in a regular way. This is the climax of the experiment, but it lasts only a half to one second. Presently the phenomenon has the aspect of the well-known lambs' wool clouds. In the most favorable moments sections appear, but they immediately vanish. The number of cloudlets may in some cases be estimated at several thousands; their size varies from 1 to 3 sq. ctm. or more.

A part of the obliterated boundaries of the individual cloudlets remain still visible some time, and expand from the middle point towards the outer edges of the smoke surface.

The production of the figures appears to M. Antolik to be

due to a communication of electricity, and not to be an effect of induction, for on introducing a thin glass disc at different heights over the smoke surface, the figures were formed only round about the glass disc, not under it. "Perhaps," he says, "the whole phenomenon may be attributed to very soft impulses of long cylindrical electric air-waves, propagated in extremely short time from the Leyden jar to the smoke surface, and causing in the cloudlets themselves a momentary separation of electricity. In this way the phenomena may be explained, yet its cause is not yet given with certainty. The production of the concentric circles may be attributed to the smoke waves arising in the streaming out from the paper funnel, the cohesion of which waves seems to persist, though at a short distance from the funnel they flow into each other. The individual smoke-waves separate from each other, and in this state go farther if the charged jar be cautiously brought nearer to the funnel. The radial division (more difficult to explain than the concentric circles) have probably their cause in the regular arrangement of the cloudlets, which flow into each other polarly."

The figures may be maintained longer if the jar be neared to the smoke-surface slowly, but they are always more and more blended.

A second phenomenon is that, if the somewhat weakened jar be brought nearer the smoke-surface, the cloudlets at a certain limit assume, instead of the roundish and elliptic forms, a ruffled (*gekräuselter*) appearance (like hat-maker's wool). Individual cloudlets rise, whirling slowly, but mostly fall back again. The ruffled cloudlets may subsist some time, especially if they occur near the edge of the smoke, where at the same time traces of the radial divisions are perceptible. M. Antolik considers them a result of electric induction.

If, now, the jar be brought quite close to the smoke layer, so that a small spark leaps to the table, the entire smoke layer is quickly driven outwards in form of a concave circular surface. But, before this stage, the smoke commonly disappears on the table, while the small carbon particles in it adhere to the table, and cannot now free themselves from it.

A third phenomenon, when it once occurs, subsists till the last moment of the experiment. There appear, namely, on the smoke layer, winding and sharply defined furrows, which swim round, shadowlike, in the layer, and follow the movements of the Leyden jar. At first there are only a few furrows, often only one; but they afterwards multiply greatly.

This phenomenon seems to point to the fact that on the head of the Leyden jar are small particles of dust, from which, as from points, the electric wind streams out in infinite fine cone-like bundles, which must be very smooth and uncommonly delicate at their surface, since the borders of the furrows they produce seem to be sharply cut. A furrow often sinks only to the half of the by no means thick smoke layer, and in it the cloudlets of the first phenomenon occur and fill it up. If we hold the jar quite still on production of the furrows, there appear only shady larger and smaller points in the smoke surface, which continuously maintain their positions, even when the smoke waves stream more quickly out of the paper funnel. If the jar be moved, however, and only two or three cone-like rays occur near each other, they wind parallel to each other. The outlines of the furrows remain visible several seconds, especially at the border of the smoke surface, where this is less movable. Once they occur, they are broader the farther the jar is from the smoke surface.

Good conductors and glass tables under the smoke layer seem to have no influence on all these phenomena. If the Leyden jar be charged with negative electricity the same phenomena occur, only the jar must be brought much nearer to the smoke.

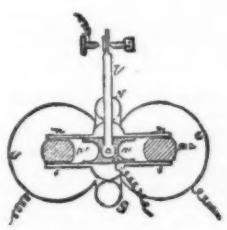
All these phenomena seem to render it probable that the lamb's-wool clouds visible in the sky have their cause in the air currents saturated with electricity. Whether these are positively or negatively electrified they must certainly act on the cooled water vapors of the atmosphere, even at a great height, either communicatively or inductively. The rarefied air must highly favor the action at a distance of the electricity, and accordingly the clouds in question may continue at rest a long time in the place of their origination.

THEILER'S RELAY.

THE peculiarity of this relay consists in the novel construction of its magnetic armature and its combination with an electro-magnet, whereby the power is thoroughly utilized.

The figure gives in plan an outline drawing of the relay. It consists of an ordinary electro-magnet, *c c*, of which p_1 p_2, are the poles. Two light tongues or bars, *n n* and *s s*, of soft iron are mounted on a pivoted axle at *a*, their flat sides facing each other, and kept a certain distance apart by a short piece of brass, shown in the figure by the dark shading. The armature, in fact, somewhat resembles a double tuning fork.

This armature is magnetized by a horseshoe permanent steel magnet, whose poles, N and S, are shown in the figure.



These poles are in close proximity to the portions of the tongues, *n n* and *s s*, which, at the middle of their length, are made to project.

The magnet poles impart similar polarity to the ends of the tongues, to which they are respectively in close proximity; consequently, when the electro-magnet becomes magnetized by a current, the whole armature tends to turn on the axis at *a*.

Fixed to the armature is a brass tongue, *l*, which is furnished at its extremity with the usual platinum contact point playing between an insulated and a contact screw.

This relay is found to give very good results, especially for fast speed working.

ZIRCONIA FOR THE OXY-HYDROGEN LIGHT.*

By JOHN CHRISTOPHER DRAPER, M.D., LL.D, Professor of Natural History in the College of the City of New York.

SUCCESS in the use of the microscope for the purpose of projecting magnified representations of microscopic objects on a screen depends primarily upon the light employed, especially when high powers are used, as for example, a quarter inch objective. To answer the purpose in question in light must possess: 1st, intrinsic brilliancy; 2d, the brilliancy must be as nearly as possible invariable; 3d, it must retain its fixity of position in the optical axis of the apparatus.

If the experimenter has a good heliostat, the light from the sun fulfills these conditions better than any artificial light; but, experience teaches the unwelcome lesson that, though sunlight is preferable to any other, it scarcely ever happens that it is available at the time it is wanted. The weather is almost certain to be either cloudy or hazy just at the hour when it is desired to make an important demonstration, and the lecturer is obliged to postpone it, thereby lessening its value, and often entirely losing its effect. The selection of the best artificial light therefore becomes a matter of importance to those who desire to secure the advantages to be derived from the successful demonstration of such microscopic objects as preparations of animal and vegetable tissues, animalcules, the circulation of the blood, etc.

The artificial lights possessed of sufficient intrinsic brilliancy are: 1st, the electric arc or light; 2d, the magnesium ribbon light; 3d, the oxy-calcium light; 4th, the oxy-magnesium light; and 5th, the oxy-zirconium light. The first has greater brilliancy than any other in the list, but in addition to fifty or one hundred cups of a nitric acid or bichromate battery a good regulator is also necessary; this involves a very considerable expenditure of money, and even when this is made, the labor and trouble required to manage the battery, and the continued change in the parts of the carbon electrodes between which the arc of light passes, render its use unsatisfactory.

The magnesium ribbon light has the great disadvantage of the emission of fumes of oxide, which coat the surface of the condensing lenses in spite of all attempts to dispose of it otherwise. The light also is not concentrated on a small fixed surface; but is emitted from a varying length of ribbon.

The oxy-calcium light produced by projecting the flame of mixed oxygen and hydrogen gases upon a cylinder or pencil of calcium oxide is the one generally employed. It is fixed in its position in the optical axis of the apparatus, it is thrown into operation with comparative facility when cylinders containing the compressed gases are available, and it has sufficient intrinsic brilliancy for the majority of experiments. The difficulties in this way of its use are however serious, and it is very desirable that they should be lessened. They arise chiefly from the volatility of the calcium oxide at the intensely high temperature employed. The volatilized material depositing on the condensing lenses prevents the passage of the luminous rays, and the cavity formed in the cylinder of lime at the spot where the flame impinges soon interferes with the brilliancy of the light; this necessitates a change in the position of the lime cylinder to present a new surface to the action of the flame, and this in its turn implies a distraction of the attention of the experimenter, which interferes seriously with the satisfactory management of his subject. Though the attempt is made to avoid this difficulty by clockwork, or other mechanical contrivances, they are still unsatisfactory in their action. Another serious objection is the necessity of placing the cylinders in a closed vessel when not in use, to protect them from the action of the air.

The oxy-magnesium light is similar to the preceding, differing only in the substitution of a cylinder or pencil of magnesium oxide for calcium oxide, and the light emitted is of equal brilliancy. Following the instructions given for the preparation of these cylinders, I have taken the greatest pains to procure samples of magnesium oxide of the utmost purity. I have also tried various methods for its preparation, among which the combustion of the metal in oxygen may be mentioned, but failure has thus far attended all efforts to make pencils or cylinders which could withstand the intense heat of the flame of the mixed oxygen and hydrogen gases without undergoing volatilization. The pencils obtained were fully equal in this respect to those of calcium oxide; but I did not find any superiority that repaid the the trouble of their preparation.

The oxy-zirconium light produced by the action of the flame of mixed oxygen and hydrogen gases on a cylinder of zirconium oxide meets all the requirements of the case in question. It has the intrinsic brilliancy, the invariable brilliancy, the fixity of position in the optical axis of the apparatus, and it does not volatilize under the heat employed. The condensing lenses remain free from deposit, and after the light is once adjusted the experimenter can carry on his demonstrations without the distraction of his attention that attends the use of the other lights. All that is necessary is, according to the size of the reservoirs of compressed gas, to open the cocks a little as the pressure diminishes. There is also no necessity to remove the zirconium oxide pencil from its position, as in the case with the calcium oxide; it may on the contrary remain *in situ* for any length of time, and the apparatus is always ready for use whenever it is wanted.

Though the standard works on chemistry generally mention the light-emitting power of zirconium oxide under a high temperature, the only successful attempt that has been made to apply it practically that I am aware of was that of Tessié du Motay. Unsatisfactory references to his process for preparing zirconia cylinders are to be found in various chemical works and journals, the best that I have seen being that given on page 47 of "Crookes' Select Methods in Chemical Analysis." The careful reader of this and other articles on zirconia will be prepared to expect difficulties in the way of its preparation, and it is to the removal or lessening of these difficulties that I now propose to address myself by the minute relation of the process I have adopted after many weeks of experiment.

The subject naturally divides itself: 1st, into the preparation of zirconium oxide; and 2d, the preparation of the cylinders or pencils.

PREPARATION OF ZIRCONIUM OXIDE.

The compound zirconium used is that known as the zircon of North Carolina. It is essentially zirconium silicate, and the composition of this and other specimens of zircon will be found in Dana's Mineralogy. The difficulty in the operation consists in the complete removal of the silica and of the sodium compounds used in the disintegration of the mineral.

1st. Select the zircon crystals or fragments thereof of as light a color as possible, and carefully remove all attached foreign matter; provide about ten grams in weight.

2d. Reduce five or six grams to powder in a steel mortar; or, by first heating to bright redness and chilling in water while very hot, the same may be done in a porcelain mortar. Remove any mica or other foreign matter that may appear.

3d. Complete the pulverization in an agate mortar, introducing small quantities at a time, and reduce to an impalpable powder. The final yield of zirconia depends on the thoroughness with which this was done.

4th. Weigh out two grams of the fine zircon powder and mix it intimately in a mortar with ten grams of dry sodium carbonate, place the mixture in a covered platinum crucible of twenty cubic centimeters capacity.

5th. Place the crucible over a strong Bunsen flame; the burner should be at least fifteen millimeters in diameter; in about twenty minutes the mass in the crucible will have shrunken to one-third of its original volume if the heat is sufficient. To secure uniformity in temperature of the crucible I have employed the following device. The platinum crucible being placed in a triangle of platinum wire supported on the ring of a retort stand, a graphite crucible having a diameter of five centimeters was taken and an opening fifteen to twenty millimeters in diameter made in its bottom. It was then placed mouth downwards over the platinum crucible, with its mouth at the level of the bottom of the latter, and resting on the same support. A brass or iron tube two and a half centimeters in diameter and six to eight decimeters in length was placed vertically over the bottom of the graphite crucible, resting on it and enclosing the opening previously made therein. A furnace was thus constructed, the long tube being the chimney, giving a good draught, and the graphite crucible the body which confined the flame to the surface of the enclosed platinum crucible and heated it equally.

6th. The shrinkage of the mass having been satisfactorily accomplished, it is to be fused; for this purpose a powerful gas blowpipe flame urged by a foot bellows answers very well. In place of the ordinary blowpipe flame I have used a modification contrived by my assistant, Mr. Ivin Sickels. It consists of a large Bunsen burner two centimeters in diameter; the upper opening is closed by a cap through which seven small tubes pass, each having a diameter of two and a half millimeters. The lower openings of the burners are also closed except one through which a tube passes and communicates with a foot bellows. Coal gas being turned into the burner, ignited, and the bellows thrown into action, seven clean sharp pointed blowpipe flames are produced which give a very intense heat.

The mass in the platinum crucible having been fused and the fusion continued until it begins to assume a pasty state, it is again liquified according to the plan of Berzelius, by the addition of caustic soda about equal in weight to that of zircon. The heat being again applied, the disintegration of the silicate continues, and if necessary a second addition of caustic soda may be made.

7th. The contents of the platinum crucible having cooled, separate them therefrom, and place in a beaker, add two hundred cubic centimeters of distilled water; any portions of the fused material that adhere to the walls or cover of the crucible are also to be removed by a jet of distilled water and added to the contents of the beaker. An occasional stirring will promote the disintegration of the mass, which is completed in the course of a couple of hours, silicate of sodium, the excess of sodium carbonate and soda, dissolving and leaving a white powder, which, according to Dr Melliss, is composed of zirconium oxide, silicium anhydride, and sodium oxide, together with any zircon that may have escaped disintegration.

The contents of the beaker are thoroughly stirred and set aside for twenty-four hours to settle. The clear supernatant fluid is decanted, another two hundred cubic centimeters of distilled water added, the mixture stirred and set aside for twenty-four hours or longer, and when the precipitate has settled the liquid is decanted and the beaker with its contents set on the water bath to dry.

8th. Pulverize the dried material in the beaker with a glass rod, add twenty cubic centimeters of pure hydrochloric acid (Merck's), cover the beaker with a large watch glass and set on the water bath; when the acid has dissolved as much as it will take up, it is to be decanted while hot into a shallow evaporating dish of about five hundred cubic centimeters capacity. A second dose of twenty cubic centimeters of hydrochloric acid is added to the contents of the beaker, and when all lumps are broken down the mixture is transferred to the evaporating dish, a little hydrochloric acid being used to complete the transference.

9th. For the final separation of the silica the contents of the dish are evaporated to dryness on the water bath, and the heat continued until they cease to emit acid fumes; a little distilled water is then added and thoroughly incorporated with the residue by stirring. The mixture is again evaporated to dryness at 212° F. The second drying being completed, about two hundred cubic centimeters of distilled water are added, and when all the soluble material is taken up the mixture is transferred to a filter. On the filter there remain silica and undecomposed zircon. In the filtrate there are zirconium chloride, sodium chloride and iron chloride.

10th. The next step is the separation of the zirconium chloride from the iron chloride, and as completely as possible from the sodium chloride. This I have accomplished as follows. The filtrate being made up to five hundred cubic centimeters with distilled water, washed sulphurous acid gas is passed through the fluid as long as a precipitate forms, or until the contents of the flask smell strongly of sulphurous acid. The mixture is then boiled as long as it emits any odor of sulphurous acid, the loss of liquid being made up from time to time by the addition of distilled water. The precipitate of zirconium sulphite is allowed to settle for a day or two and is then collected on a filter, where it must drain for a day, the funnel being covered with a sheet of paper. As it is impossible to wash the precipitate properly on the filter, it must be carefully transferred therefrom to a beaker while it is still moist, by means of a glass rod and jet of distilled water from a washing bottle. The lumps being completely broken up, the contents of the beaker are again made up to five hundred cubic centimeters with distilled water well stirred, and when the precipitate has settled it is collected on a filter as before and allowed to drain as long as it will yield any fluid.

11th. The precipitate obtained above is dissolved in as little pure hydrochloric acid as possible, the solution diluted with distilled water to five hundred cubic centimeters and heated to boiling for some time. Ammonia is added to the

*American Journal of Science.

hot solution, when the zirconium oxide is thrown down and is to be collected on a filter, washed with hot water and allowed to dry at the temperature of the air, the yellowish or whitish lumps resulting are pulverized in an agate mortar, when a white powder is obtained. The quantities I have given in the various operations detailed above apply to two grams of the powdered zircon. For the preparation of a zirconia cylinder of sufficient size the product from four grams of zircon is required; the quantities may be doubled throughout; but it is better to make two fusions of two grams each and double the quantities given in the latter part of the description.

I have also tried the separation of zirconium chloride from iron chloride by hydrochloric acid; but, though I worked at a temperature of 32° F., the yield was very small and therefore unsatisfactory. In the process by hyposulphite of soda I found it very difficult to get rid of the soda. The process of disintegrating the zircon by chlorine at a high temperature also failed to give satisfactory results in my hands, and I find that Dr. Melliss records the same experience.

PREPARATION OF THE CYLINDER.

The zirconium oxide powder obtained in the manner described above is to be heated in a platinum crucible and kept at a bright red for five or six hours; it will under these circumstances shrink considerably in volume. I have sometimes in addition submitted the powder to a heat of the oxy-hydrogen flame with advantage, spreading it out for this purpose on a piece of platinum foil supported on a slab of iron, and directing the flame on the powder. The operator should wear smoked spectacles. The powdered oxide thus condensed by heat is then moistened with just enough water to give it a tendency to form small lumps. In this condition is placed in a cylindrical mould and submitted to severe pressure by a piston fitting closely to the cavity of the cylinder, both of which should be properly oiled. The size of the pencils I have prepared is about six millimeters in diameter and one centimeter in length. When in use they are mounted so as to present one end to the action of the oxy-hydrogen flame, when a brilliant circular spot of light is formed, admirably adapted for all kinds of optical experiments.

The cylinder in which the pencils have been compressed is about two centimeters in diameter and four centimeters in length; the cavity running centrally through it is six millimeters in diameter, the piston rod fits closely, and both it and the cylinder are of hardened steel; the source of compression is a small hydraulic press, and the pressure employed is about two tons. The pencil is forced from the cylinder after compression by the press itself, and is very hard. It is allowed to dry slowly and then ready for use. When first heated the temperature is gradually increased until at last the full force of the oxy-hydrogen jet is employed. In case the pencil chips or loses any part of its substance the portions are to be preserved and ground up with old pencils in an agate mortar mingled with a little fresh zirconia powder and compressed in the cylinder. The pencils thus obtained from portions of older ones are generally superior to those made entirely from fresh oxide.

In the process of Tessié du Motay certain agglutinant materials are employed in preparing the pencils; but these reduce the brilliancy of the light considerably. With care in the management of the pencils the use of agglutinants may be avoided; and though they may be necessary in case of pencils to be handled by an ordinary peripatetic calcium light manipulator, they are not only unnecessary in the hands of a lecturer, but are also detrimental exactlyin the proportion in which they reduce the brilliancy of the light.

If the zirconium oxide is free from silica there is no evidence of fusion on the extremity of the pencil, though it may have been submitted to the action of the flame for a full hour. If on the contrary silica is present the spot on which the flame impinges becomes glazed, giving evidence of fusion, and the brilliancy of the light decreases greatly. The pencils made from the zirconia prepared in the manner related above have been tested alongside of those made from zirconia prepared by Merck, which is stated to be pure, and is sold at the rate of one dollar per gram. Whatever the process may be that is used in its preparation, it does not give a product as free from iron and silica as the one which I have described, nor does it possess the same illuminating power.

A NEW MORDANT.

It is well known that coloring matters soluble in water absorb certain matters in the condition of powder with an avidity apparently equal to that with which they absorb colors known as substantive. It is known that starch takes up and holds the substantive colors of aniline with considerable force, so that by treating the dressing in powder with cold solutions of aniline colors colored powders are produced which are used in various ways in the production of paper-hangings. It is known that the colorless precipitates forming in solution containing coloring matters absorb considerable quantities, although they themselves become but slightly colored. Thus are produced very elegant results with sulphate of barytes in solutions containing aniline colors. These precipitates have heretofore had but a secondary interest in the art of dyeing. And there is not yet a single pulverulent or porous substance known which will act like filamentary matters in substantive as well as adjective colors.

By experiments and experience in the dyeing of cotton with aniline colors and other processes, M. Reimann has demonstrated the enormous power of silica and animatous substances in absorbing coloring matters. A combination of silicic acid had already been colored by substantive matters, and attempts had been made, with more or less success, to color mica in powder with the brilliant aniline pigments, but the experiments had not been extended to the compounds of silica.

The silicic acid precipitated from a solution of soluble glass by means of acid in the form of jelly, and which, transforming itself into an impalpable white powder by drying, shows in a most convincing manner the property it possesses, when brought into contact with solutions of substantive colors, of taking up the coloring matters they contain, and with adjective colors after mordantage to act in precisely the same manner as textile fibres, the colors being as fixed as on cotton.

The aniline colors are these which the most readily combine with silica, which they seem to color in a permanent manner. When solutions of fuchsine, aniline blue, violet, etc., are agitated with silicic acid precipitate, as above described, and carefully washed, the acid soon assumes a decided color, which it retains after washing, though hot water on alcohol will cause it to disappear. But the same occurs in the case of fibre dyes, such as cotton, from which the color is discharged by the same means. The tinted amorphous silicic acid yields pretty colored powders, which may be useful in the manufacture of paper-hangings.

It would, however, be very much more important if these phenomena could be turned to account in dyeing. It is easy to fix on fibrous substances, such as cotton, which do not take substantive colors directly and without preparation, aniline dyes by means of silicic acid. When the fibre of cotton, which is exceedingly rebellious against coloring matters, is simply impregnated with a compound of silicic acid easily decomposed, it absorbs colors, especially those of aniline, which possess in themselves all the properties of substantive colors.

A simple passing through a solution of soluble glass gives cotton the property of absorbing colors; but it is better to decompose the soluble glass upon the cotton by impregnating it with an alkaline solution of silica, and afterwards plunging it into diluted acid. By this plan the cotton, which is then washed and afterwards dyed in a solution of the color, when it takes a bright and fresh tint, which, moreover, is more permanent than any that can be obtained by the numerous mordants in use.

It is well known that the mordanting of cotton for aniline dyes consists in the use of an acid with which roseaniline, trimetrylroseaniline, etc., form soluble salts with difficulty, if at all. Tannic acid, on account of the insolubility of its salts, is generally preferred for this purpose. But the combinations with tannic acid do not give color so fresh as those obtained with other means, and their effect is always rather dull. This fault is entirely prevented by the use of silicic acid. It has been found in practice that aniline colors produced with its aid on cotton are more pure and resist soap and alkalies better than those obtained with other mordants.

The powerful attraction and fixation of silicic acid for coloring matter is still better understood when it is seen that wool, in direct opposition to its action with analogous colors, will not take aniline green; whereas, if passed through the solution of soluble glass, then dyed in a tepid solution of green, and finally passed through acid, it dyes perfectly. The methods above described have been applied to cotton on a large scale with highly satisfactory results.

M. Reimann has also experimented on the use of silicic acid in dyeing with adjective colors, and has found that it takes up acetate of alumina, acetate of iron, etc., from the various mordants precisely in the same manner as cotton; and consequently, the dyeing of black, etc., succeeds very well.

It was thought necessary to ascertain whether silicic acid, like mica, was not united to the coloring matter by a superficial attraction, or whether the affinity might not be attributed to a small proportion of alkali in the precipitate. This latter supposition obtained all the more attention from the fact that, for about a year, it had not been noticed that aniline colors could be fixed on cotton by an alkaline mordant. M. Reimann had, in consequence, sought to obtain all the colors got with silicic acid on glass itself, with fluoric acid as a mordant. If the affinity for the coloring matters only depended on the presence of an alkali, the experiment on the glass would give a negative result, as it could not be conjectured that the glass contained any soluble alkali. If, on the other hand, the affinity rose from a physical quality of its surface, the glass must give the same or similar results. And so it turned out; the glass mordanted on the surface with fluoric acid took the aniline colors as well as the amorphous silicic acid, and it was found that, with an iron mordant and logwood, the glass could be dyed black, rusty yellow, potash, etc. In consequence of the shallow action of the fluoric acid on the glass, the tints, which approach those of the silicic acid, are rather light, but wherever the acid has taken, the color is as perfectly fixed as with silicic acid.—*Polytech. Journal.*

SILK PRODUCTION.

England alone consumes 4,000,000 lbs. of silk annually, and, at most, every pound requires 3,500 worms. China has consumed fifty times the quantity for 3,000 years, silk being the universal item of clothing there. It is produced mostly between the 30th and 40th degrees of latitude. The East India Company used to import vast quantities of silk from China, and the quality was always the same. It requires 14,000,000,000 of silkworms to produce the silk consumed in the United Kingdom. Lyons has 22,000 silk looms, and France manufactures nearly 3,000,000 lbs of silk. Italy produces 4,000,000 lbs.; Turkey produces 2,000,000 lbs. Russia manufactures silks at Novgorod. In 1838-9 France manufactured 22,000 bales of silk, or about 60,000,000 lbs., and America nearly as much. The silkworms prefer the white to the red mulberry, and the red to the black. The trees are raised by cuttings, layers, or by seed and transplanting. No other insect eats the leaves. When eight days old the worm is already three days in its first moulting; in five days its second moulting takes place; in five days more, a third; and, in another five days, a fourth. In three or four days it encloses itself in its cocoon, and becomes a chrysalis, all in about 29 or 30 days. Then it required a temperature of 65° to 70°; eggs require 45°. It remains in the chrysalis form from two to four weeks, and escapes from the cocoon (by dissolving the gum which holds the threads, and not by their ruptures) as a large moth. Every female lays about 350 eggs, of which 391,680 weigh one pound troy. But, when full grown, 50 weigh a pound, having increased 9,000 times. In 1,000 ounces of cocoons the pure silk is only 150 ounces, and in reeling 100, and sometimes even 80 only; an ounce of eggs yields about 1,200 ounces of cocoons. Five pounds of reeled silk have been produced in England from 1,200 worms; 97·5 lbs. avoirdupois of mulberry leaves yield 10 ounces of reeled silk, or 156 to 1. Cocoons from lettuce leaves are one seventh less, and the worms die. The coarse floss is a twentieth of the pure cocoons. The length of the fibers in each cocoon varies from 300 to 600 yards; 12 lbs. of cocoons yield on the average one pound of reeled silk, from which is made 15 yards of Gros de Naples. Every fiber of silk will sustain a weight of 50 grains. One third of the silk manufactured in England is exported to the United States, and a sixth to Canada and the West Indies. Spitalfields manufactures three sevenths of the broad silks, and Manchester two sevenths. Coventry and Macclesfield are the chief manufactories of ribbons, worth £1,750,000, and equal to one fiftieth of the whole consumption. Nearly two shillings a pound is paid for silk, and the national returns depend for repayment on the exports of one fifth to all parts of the world. Not less than 4,000 lbs. of raw silk are used weekly for making sewing silks, which employs above 2,000 hands at 5 and 6 shillings a week. The reduction of duties on raw silk in 1852 greatly increased the manufactures, which, subject to oppressive duties, could not compete with the French fabric. The annual consumption is estimated at about 4,000,000 lbs., of which nearly two-thirds is in piece goods, a fourth ribbons and handkerchiefs, and a twentieth in sewing silks at a cost of 17s. a pound, exclusive of 2s. for throwing. The cost of labor in all branches—winding, weaving, dyeing, etc., is about £3,250,000, divided among 180,000 persons, at an average wage of only 8s. per week. The total returns are about £10,500,000, leaving £2,750,000 for machinery, profits, etc.—*Himalaya Chronicle.*

DETECTION OF ORGANIC COMPOUNDS IN VEGETABLE TISSUES.

By Dr. Ottomar Herrmann.

For the micro-chemical detection of datiscin the author recommends the application of lime or baryta-water, which gives an intense yellow color to the cells containing the glucoside. On the addition of acetic acid or dilute hydrochloric acid this color at once disappears. In order to detect berberin we may use nitric acid. On merely examining plants containing this alkaloid we find in certain parts cells filled with a gold-yellow liquid or intense yellow membranes. On the addition of alcohol and very dilute nitric acid this color disappears in a short time, and numerous gold-colored crystals are formed, which chiefly occupy the interior of the cells in stellar groups. Sulphide of ammonium occasions a brown coloration. Colchicin takes an intense yellow coloration in contact with alkalies. To detect chloridzin we may utilize its deep brown-red solution in ferric chloride, and its brown-yellow precipitate with ferrous sulphate. The presence of a small quantity of tannic acid renders the color deeper, but does not effectually mask the reaction. Larger quantities of tannin interfere. Curcumin is dissolved by mineral acids with a carmine red color, but not without decomposition. Its solutions give red-brown precipitates with the salts of lime and barium, and fiery-red precipitates with the salts of lead. Nucin may be recognized by the purple-red color which it assumes with alkalies, preferably with the fumes of ammonia. The color is not permanent, and soon passes into various shades of brown. The author detects rutin by the intense yellow solutions which it forms with carbonated and caustic alkalies, lime and baryta-water, and which on exposure to the air take up oxygen and turn brown. Plumbagin dissolves in alkalies with a red color, which passes into yellow on the addition of an acid. Chrysophanic acid is recognized by the splendid purple-red color with which it dissolves in aqueous alkalies. Frangulin takes a carmine-red with dilute potassa.

HARDENED GLASS FOR LABORATORY PURPOSES.*

By J. W. Swan.

"To supply me with flasks and beakers, almost as resistant of the destructive agencies of fire and hard knocks as cast-iron." This was the attractive proposal made to me a few days since by the representative of a company now working M. de la Bastie's process for hardening or tempering glass. Samples were provided, not of flasks and beakers, but of other vessels that would sufficiently illustrate their properties. I immediately, and with great eagerness, gave myself up to experiments with some of the vessels. Some of them are here to-night, and are at the service of the members for the purpose of experiment. The results of my experiments are at least interesting. I found that even in a very thick basin water might be boiled, by means of a naked flame strongly playing upon it, without fracture; that the hot vessel might, without harm, be lifted off the stand with cold tongs and set upon a cold plate of iron; that altogether it bore an amount of ill usage that was extraordinary. Then I thought I would subject it to a severer test; I therefore only partly filled the basin, and allowed the flame to play upon a larger surface of the glass than was covered by the liquid, so that the margin of the basin might be heated above the boiling point. I did this with the idea that probably under those conditions the temper of the glass might alter or be destroyed where the glass was more strongly heated, and if it was destroyed, that fracture would almost certainly result. The agent of the company said no, but the fragments—the result of two experiments of exactly the same kind—say yes. The character of the fracture is worthy of attention; you will observe that the bottom, which was covered by the water, is broken in small pieces like hardened glass, and that the rim has broken in larger pieces with sharp-cutting angles—in fact like ordinary untempered glass. Possibly tempered glass may in some instances prove useful in the laboratory—for the much-abused water bottle for example—but for general purposes of the analyst, in place of flasks and breakers of thin glass, the experience which I have so far had of it makes me very doubtful of its utility.

WASHING OUT FLASKS BY INVERSION.†

By Dr. P. Townsend Austen, New York School of Mines.

To wash a precipitate out of a flask would seem to be an easy manipulation, but yet the extraction of the last particles is often a tedious operation. This is particularly true in the case of small grains of sand or mica in the analysis of silicates, as well as with heavy gelatinous precipitates.

By using the following simple method a flask may be washed out at a single operation.

1. The flask contains a hot liquid.—The flask, which ought for the sake of convenience to be half full, is suddenly inverted‡ in a dish, the larger the better, containing about as much liquid as in the flask. This operation requires a little skill. It is most easily performed by holding the flask over the rim of the dish, then gradually inverting the flask, and, as soon as the liquid begins to flow out, suddenly inserting it, putting the mouth of the flask entirely under the surface of the liquid, and at the same instant bringing it by a swift movement to the middle of the dish. After a few seconds the cooling of the air in the flask occasions a partial vacuum, and the liquid rises in the flask. If the liquid has been at a boiling temperature the flask will be almost filled. After allowing the liquid to ascend, the flask is firmly held by the neck with one hand,‖ while the other grasps the

* Read before the Newcastle-upon-Tyne Chemical Society, March 22, 1877.

† This method is not very applicable, however, to liquids holding light powders in suspension. By standing as in the silver assay and allowing the substance to settle, agitating occasionally to prevent its deposition on the bulge of the flask, even suspended powders may be removed.

‡ I much prefer this to corking the flask, inverting, and then removing the cork.

‖ Protected by a felt pad if necessary.

bulge. By gently shaking the flask the liquid slaps against the top (bottom) and sides, thus dislodging completely all adhering particles. A slight revolving motion is then given, and the heavy solid particles go quickly down through the neck of the flask into the dish. After all the substance has been removed, the flask is gradually tilted and the liquid allowed to run out. This operation also requires a little skill. If a bent glass tube be introduced into the flask, a quick exit of the contained liquid is effected. Care must be taken that the dish holds easily the additional amount of liquid contained in the flask, and that the liquid in the dish is warm.

2. The liquid in the flask is cold.—The flask is inverted in the manner described. A bent tube is introduced into the flask and the air partly drawn out. The operation is then conducted as in the other case.*

After this treatment it will be found that the flask is completely free from adhering particles.

CRYSTALLIZATION BY GRADUAL DILUTION.

It became necessary for me, not long since, to obtain some perfect crystals of a substance with which I was working, and I experienced considerable difficulty in obtaining solvents which would yield me the desired results.

The fact of argol being deposited by the gradual dilution of alcohol, wherein it is insoluble, struck me as affording a clue to the right manner of crystallizing in general, and of this case in particular.

I dissolved the substance (dinitro-brom-benzol) in boiling glacial acetic acid, allowed the solution to cool to about 70°, and then added an equal volume of absolute alcohol, at a temperature of about 50°, stirring all the time. If the substance showed signs of separating prematurely, a little more acetic acid was added. The mixture was then allowed to stand in a warm place. The crystallization soon began. The formation of acetic ether † keeps pace with the separation of the crystals, so that, as the substance is withdrawn from the solution, the water resulting from the formation of the ether dilutes the solution, thus keeping up a continuous separation. The ether may be allowed to evaporate, so that finally a very dilute acetic acid solution, containing but little of the substance, is left behind. I have tried this method with various substances and have been rewarded by beautifully formed crystals. I have noticed that many of the crystals obtained in this manner were remarkably transparent. The only requisites are naturally that the substance to be crystallized must be soluble in acetic acid, alcohol, and acetic ether, and insoluble in water.

It is often necessary to allow solutions to cool off very slowly. For this purpose I find the cork box, to which attention has so often been drawn, to be most admirable. The cork should be about an inch in thickness and covered with the pads of felt previously mentioned. If the liquid is to be kept from the air or from motes, or other nuclei forming specks of matter, it should be boiled in a beaker, or glass vessel, having a ground rim, and while boiling quickly covered with a ground-glass plate. A brush dipped in a solution of pure rubber in chloroform is run around the line of jointure of the two surfaces. This forms a connecting film impervious to both air and moisture.

POLYGONOSCOPE.

A NEW optical instrument has been invented by Mr. Ezra Hatton, of Manchester, England, ornamental metal worker, for producing and displaying an infinite number of designs and patterns, which can be copied or photographed, and may be used for art manufactures, for amusement, or for other purposes. The instrument consists of two mirrors of any desired shape or size, fixed in and protected by a case or frame of metal or any other suitable material; these mirrors are connected together by means of a universal hinge, which is so arranged that the mirrors can be set and fixed at any angle to produce any required design. One of the mirrors is loose in its frame, and can be moved toward or from the other, so that at whatever angle they may be fixed the edges of the mirrors can be made to touch each other, thus preventing the pattern or design from being broken in the center. The apparatus can be closed up in a portable form, similar to an ordinary pocket book. Patterns having any number of angles or sides may be produced by varying the mirrors. The improved hinge for connecting the frames of the mirrors consists of three joints, that is to say, one joint for each frame, and a center joint on which the other two hinge. By this means the frames can be opened to the full extent, and turned back to any angle, and they can be folded close together. This hinge is applicable to articles of furniture, and to other appliances. The above resembles the common kaleidoscope which is sometimes used for the same purpose.

"PLASTIC CRYSTAL" OF DINAS.—C. Bischof.—The substance so named is a variety of Portland cement remarkable for its plasticity, and consisting of—

Silica	86·42
Alumina	9·33
Oxide of iron	0·86
Lime	0·34
Magnesia	0·22
Alkalies	0·37
Loss on ignition	2·40
	99·94

—*Dingler's Pol'yt. Journal.*

HOW TO AVOID THE BLACKENING OF WINES.—Dr. P. Wagner.—The author recommends that no article of iron, such, as nails, screws, etc., should be allowed to come in contact with the wine.

FIXATION OF INDIGO UPON TISSUES.—M. Prud'homme.—After giving a brief summary of the present methods of fixing indigo upon tissues, the author proceeds:—"We have recently discovered a new method of reducing and fixing indigo, which, without great practical value, presents nevertheless some interesting peculiarities. A mixture of glycerin, carbonate of soda, and protoxide of tin, in a paste, reduces indigo perfectly at about 120°. If water is used instead of glycerin, the reduction is incomplete.

*It often occurs in analytical operations that the increase of volume in the liquid is not desirable. Excellent results may be obtained by rapid inversion of the flask in an empty dish. As soon as enough of the liquid has escaped to cover the mouth of the flask, the settling of the precipitate begins. The admission of air bubbles caused by the cooling of the liquid does no harm.

†$CH_3.COOH + CH_3.CH_2.OH = CH_3.CO.O.CH_2.CH_3. + H_2O$.

NEW PHOTO-PRINTING PROCESS—THE DESPAQUIS METHOD.

By ERNEST LACAN.

M. DESPAQUIS forwards me some details of his photo-mechanical process in greasy ink. This process is based upon the double exposure of the gelatine; that is to say, after the plate covered with gelatine is put under a cliché in the ordinary manner, the former is turned round and exposed to light a second time from the back, until the action of the rays have met together. A glass plate, by reason of its transparency, is especially adapted for the vehicle of the gelatine, and it is upon the latter that the printing is done, in the same way as Albert, of Munich, and others proceed. Thanks to its supple character when wet, the film of gelatine is less open to injury than even steel, and it permits of a much larger number of impressions being taken than if it were metal. Other reasons are in favor of the printing being direct from the gelatine. Gelatine will not adhere to a polished metal surface, and will adhere but slightly if it is grained. To work a grained copper plate, the same must be coated with a thin film of gelatine, so that the large transparent portions of the clichés allow the light to pass as far as the metal itself, and in this case the grain of the copper is entirely reproduced upon the image, giving the latter a very disagreeable appearance; only a limited supply of copies can be struck off in this case, and these are of a defective nature. If the film of gelatine is a thick one, the grain is less apparent, but then but a very few prints can be pulled, because of the tendency of the gelatine to swell up when moistened.

Even with the process of M. Despaquis (exposure of the film to light on both sides) it is necessary to employ polished plates. No matter how finely a glass is grained, the grain always appears upon the print in the end, and takes away from its delicacy. One other condition is indispensable to success: it is necessary that the film of gelatine upon the glass should be of uniform thickness throughout. The manner of operating adopted by M. Despaquis is as follows:—After the gelatined plates have been exposed to light from the back, as M. Albert, of Munich, recommends, they are placed in a perfectly horizontal position in the drying cupboard, employing a water level to ascertain if this is the case. A solution composed in the undermention d proportions is, in the meantime, prepared, namely:—

Ordinary water	1000 cubic centimetres
Strong gelatine	25 to 30 grammes
Bichromate of ammonia	6 to 7 "

The bichromate is dissolved in one hundred cubic centimetres of the water, and then the remaining nine hundred are added in which the gelatine has been previously dissolved. The filtration of the liquid is conducted by means of the paper or fine linen. The drying chamber is warmed so that the gelatine surface should not set before it has become perfectly level, a result which might happen if the chamber were cold. Then the solution is poured upon the plates in such a way that the superfluous liquid escapes at the margin, and leaves a perfectly uniform film. So that the fluid may run the more uniformly, it is well to wet the margins of the plate by passing the finger along them. When this second film has dried, you may then proceed without fear to expose the plate a second time under the cliché. The process, in a word resembles very much that of M. Albert, of Munich, but there are some important differences of detail which are said to have much influence upon the result.—*Photographic News.*

DESIGN OF OLD GERMAN CARPET, REPRODUCED BY CHARLES GIANI, VIENNA.—*From the Workshop.*

REMOVING VARNISH.

MANY methods have been suggested for removing the varnish from old plates. A mixture of benzin and alcohol in equal parts, agitated and poured on the plate, generally acts very quickly and very well. The last traces of reduced silver which may yet adhere are then removed by iodized alcohol (alcohol 100, iodine 0.50). When the surface is properly cleaned it is rubbed over with the finger or a tuft of cotton lightly impregnated with tallow, and wiped dry.

Plates thus prepared may be kept indefinitely, and are protected from dampness, the enemy which too often imposes itself between the collodion and its support. It is well to rub the plates, whatever may have been the previous mode of cleaning, with a little talc, which increases the adherence of the sensitized coating, and does away with the gelatin or albumen, the use of which would otherwise be indispensable for the preparation of dry plates.

INSTANTANEOUS PHOTOGRAPHY.

MR. MUYBRIDGE, the photographic artist, succeeded last July in taking "Occident" while trotting at the rate of a mile in 2·27. The negative was exposed for less than the one-thousandth part of a second, yet the positive printed from it is perfect in the most minute detail. Mr. Muybridge says the exposure was made while "Occident" was trotting past him at the rate of 2·27, accurately timed, or thirty-six feet in a second, about forty feet distant, the exposure of the negative being less than one-thousandth part of a second. The length of exposure can be pretty accurately determined from the fact that the whip in the driver's hand did not move the distance of its diameter. Mr. Muybridge intends

to take a series of pictures, showing the step of "Occident" at all its stages, and in this manner, for the first time, the precise difference in the motions of different horses can be clearly represented—a matter of much interest to horsemen, for trotters vary in their action, one having his fore-leg straight when it touches the ground, another crooked, and so on.—*San Francisco Post.*

PLATE-IN-THE-BATH PICTURES.

By Fred. Scott Archer.

The bath is about three parts filled with a solution of nitrate of silver of the usual strength, and the prepared glass (as soon as the film of the collodion has set) is plunged into it. The whole is then placed in its proper position in the camera—the focus having been previously obtained, and the light is thus allowed to act on the prepared film, whilst in the bath of nitrate of silver. By this means, great cleanliness is preserved in the manipulations, and very delicate pictures are obtained. I have used this bath during the whole of the summer and autumn, and several friends, at my suggestion, have adopted it with great success. The bath is made in two pieces of the best plate glass, connected together at the sides and bottom, and gradually tapering downwards, so as to form a narrow wedge-shaped bath; the top being about three-eighths of an inch wide, and the bottom one eighth. This bath is cemented into a wooden frame, having a closely fitting lid to prevent all dust falling into the solution.

MEASUREMENT OF HEIGHT OF CLOUDS.

By A. Mallock.*

If the clouds remained practically stationary for any time, and with their contours unaltered, there would be no difficulty in measuring their height, for if such were the case the observers might agree to measure the altitude and position of some prominent feature in a cloud at the ends of a measured base, which would, of course, give the necessary data; but in general the clouds not only move too fast for this to be done, but their contours, partly from the effect of perspective and partly from other alterations, change rapidly also, so that what perhaps was at one moment a well-marked feature may in five minutes become unrecognizable.

The observations, then, by which the heights of clouds are to be measured, must first of all be simultaneous, and they ought to be made on as many points as possible to obviate the unavoidable uncertainty as to the actual identity of the points observed at each station.

To secure these objects I had recourse to photography, and the way in which the photographs were taken and analyzed I will now describe. A pair of cameras, of one of which Fig. 1 is a section, were placed one at each end of a measured base-line, and the lenses pointed to the zenith by means of the leveling screws A A.

The dark slide (B) fits as a drawer below, and consists of a shallow box, the lid being opened after it is placed in position by means of the milled head (C). Simultaneous exposure of the sensitive plates is insured by uncovering the lens by an electric magnet apparatus (E), both cameras being in one circuit.

After a photograph is taken it is necessary to know the exact position which the plate occupied with reference to the lens; and as it would be impossible—or, at least, very inconvenient—to be obliged to have all the plates and fittings of the slide made with sufficient accuracy to obtain this knowledge, I have made use of an easier, and, at the same time, a more efficient plan.

H is a horizontal axis, fixed in one side of the camera, movable from the outside by the milled head (K). On this axis, in the same plane, and terminated in sharp points, are two arms (L), which, in their ordinary position, lie back flat and upright against the side of the camera; but after the photograph has been taken, and before the dark slide has been touched, the head (K) is turned so that points descend on the plate and puncture the film in two places. As the axis (H) is fixed in the camera, and, therefore, fixed as regards the lens, the two punctures left on the film leave a trustworthy record of the position of the plate at the time of exposure.

The constants, which must be known for each camera before the photographs can be analyzed, are:

1. f, the distance of the optical center of the lens from

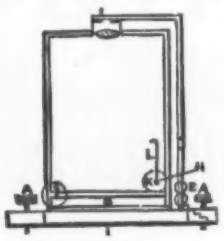


Fig. 1.

the plate. 2. The co-ordinates, x' and y', of that point in the plate which corresponds to the zenith, the axis of x passing through to the points marked on the film, one of them being the origin.

To obtain these co-ordinates I photograph a target (Fig. 2) placed in the zenith at such a distance from the camera that a well-defined picture may be taken without altering the adjustment of the lens. A plumb-line passes through the center of the target, and the camera is placed in position by its means. x' and y' (Fig. 3) are then the co-ordinates of the center of the target in the photograph. I may here remark that any small difference between the optical and geometrical center of the lens, such as is often found to exist, will produce errors of the second order only in the result. A comparison of the actual size of the target with that of the photograph will, of course, give f, but for greater certainty I measured f also by taking another photograph with the camera displaced horizontally by a known amount from its first position immediately under the target.

Having got these constants, the analysis of any pair of photographs is very easy. What has to be found is the tangent of the parallax which the cloud would have if it were immediately over one of the cameras, which may be expressed in this case as the difference of the projections on the line joining the two cameras of the distance of corresponding points in the photographs. [The author then described the trigonometrical method of calculating the parallax, and finally showed that $h = p.\ l.$, whence h = height of the cloud, l = length of the base, $p = \frac{d}{f}$, d being the difference of the measured points in the photographic paper, and f the focal length of the lens.]

It will be noticed that it is not the distance of the cloud from the camera, but its perpendicular distance from the earth, and this due to the fact of the plate being horizontal, that is concentric with the surface of the earth. What is really measured is the distance of the cloud from the plane of the plate, so that had any other direction than the vertical been given to the camera—which, of course, might be done—another factor, the same nearly of the angle of elevation of the camera, would appear in the result. There are several

Fig. 2

advantages, however, in placing the cameras vertically, among which may be mentioned that it is always easy, by means of levels, to ensure a known line in each instrument being vertical; whereas to ensure parallelism in the direction of the camera in any other case requires an adjustment in azimuth, which becomes more and more important as the direction chosen deviates further from the vertical. The disadvantage of placing the cameras vertical is that very often the clouds which it may be required to photograph do not show in the field.

With regard to the practical part of the analysis, I find that the quickest and most convenient way of finding d is to place the negatives side by side in a frame fitted with a reflector, and with a fine needle to mark a number of corresponding points in each picture; the co-ordinates of these points are then measured by a micrometer, and the points so found, together with the zenith points, are plotted to an enlarged scale, one set of measures being plotted on tracing paper. The tracing is then applied to the other drawing, so that the corresponding points in each may fit as well as possible. The distance between the zenith point in the tracing and drawing = d, and the line through them is the

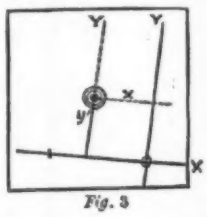


Fig. 3

direction of the line joining the two cameras. I find it quicker to arrive at the direction of the base-line by drawing than by calculation, while at the same time the drawings give greater facility for distributing the errors advantageously. As to the length of the base-line to be employed, I should say that the shorter it is in reason the better. That which I used was about two hundred yards. Undoubtedly the shorter it is the more convenient, and also, as clouds are often very thick, their contours may, if the base be long, be so different, according as to whether they are seen from one end or the other, as to make the photograph practically useless.

The results obtained are, I have reason to believe, accurate within five per cent, which is quite near enough for all practical purposes. This refers principally to measures of high clouds. Rain clouds were found as high as 4,000 feet. Cumulus was seldom lower than 6,000 or more than 8,000 feet; cirro-cumulus up to 20,000, and cirrus to 28,000 and 80,000 feet. Isolated measures like these cannot, of course, lead to much; but if this method was used systematically at observations, much interesting information might, no doubt, be obtained about the formation of cirrus clouds, and also about the winds in the higher strata of the atmosphere.

NEW MICROSCOPIC ATTACHMENT.*

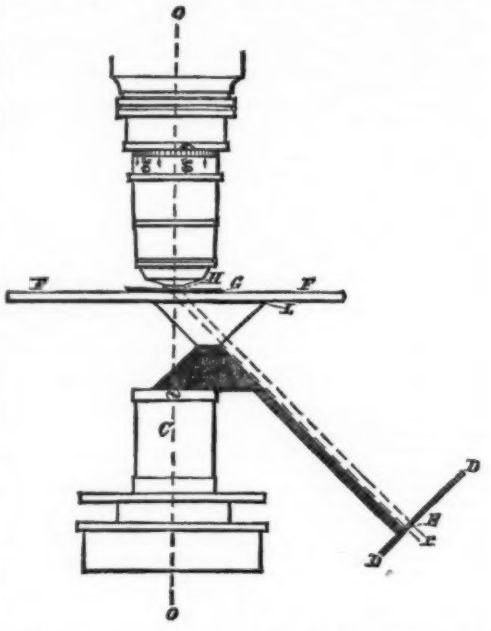
A Simple Device for the Illumination of Balsam-mounted Objects for Examination with certain Immersion Objectives whose "Balsam Angle" is 90° or upwards.

By Surgeon J. J. Woodward, Brevet Lieut.-Col., U. S. A.

Certain immersion objectives are so constructed that they are capable of admitting rays which enter the front lens at a greater angle with the optical axis than the limit for dry objectives. That this is not only theoretically possible, but that such objectives have been successfully constructed, was several years since demonstrated, in the *Monthly Microscopical Journal*, both by Mr. Keith and myself,† notwithstanding which, the contrary has often since been energetically asserted by writers in the same journal.

Meanwhile, immersion lenses possessed of the excessive angle in dispute continue to be put into the market by more than one maker; and perhaps some of the purchasers will be interested in a simple device which I have used for some time with such objectives to illuminate test-objects mounted on balsam. The device consists merely of a right-angled prism of crown glass mounted beneath the stage in such a manner that its long side can be connected, by oil of cloves or some similar fluid, with the slide on which the object is mounted. The details of the plan will be understood from the diagram annexed, in which the glass prism is seen in section just beneath the object-slide F F. Just below it is another right-angled prism, of the same dimensions, made of brass; the section of this prism is indicated by dark shading in the diagram. The right angles of both prisms are truncated, and the facets are cemented together in such a manner that the long sides of the prisms are parallel. The brass prism slips transversely in a groove in the top of a holder, C, which is fitted into the sub-stage of the microscope. D D is a blackened brass screen held in position by two brass arms, one of which is shown in the figure. This screen is parallel to the adjacent face of the glass prism, and has in it a small circular aperture, E, about the size of a large pin-hole. The side of the glass prism next the screen is covered with black paper in which is a corresponding pin-hole. The two pin-holes are so placed that a beam of parallel white sunlight (r) passing through both will be perpendicular to the side of the glass prism on which it impinges.

To use this apparatus it is adjusted in the sub-stage of the microscope, a drop of oil of cloves is placed on the upper face of the prism, the glass slide F F, on which the object is



mounted in Canada balsam under the usual thin cover, G, is placed on the stage, and the sub-stage is racked up until the drop of oil of cloves is spread out into a thin layer, I.

The object being thus arranged, it is evident that if a beam of parallel solar rays (white sunlight), reflected from a plane mirror, be thrown through the two apertures upon the face of the prism, being perpendicular to that face, it will enter and pass through without refraction until it reaches the upper surface of the thin glass cover G. The parallel rays impinge upon this surface, as is evident from the construction, at an angle of 45° with the optical axis O O. If, now, the medium next above the thin cover, G, be air, this obliquity will be greater than the critical angle, and total reflection of the rays will take place. If, however, the medium next above the thin cover be water, the obliquity will *not* be greater than the critical angle. Refraction having taken place, the rays will enter the water, H; and if an immersion lens of sufficient angle of aperture be focussed upon the objects mounted beneath the cover G, these rays not merely enter the front of the objective, but will form a well-defined image of the object on a brightly illuminated field, which will be visible through the eye-piece of the instrument in the usual way. Of course it is evident from the diagram that with no dry objective, or any immersion objective of less than 90° balsam angle, can anything whatever of balsam-mounted objects* thus illuminated be seen.

Immersion objectives may be divided according to their behavior with this apparatus, into three classes: 1st. Those with which, since they do not have sufficient angle of aperture to admit the illuminating pencil, nothing can be seen, precisely as in the case of dry objectives. 2d. Those which have sufficient angle of aperture to admit rays of this obliquity, but are incapable of bringing them to an image-forming focus; with these the field appears well illuminated, but the objects are not well defined. 3d. Those which not only admit rays of this obliquity, but form well-defined images with them. To this class belong not merely immersion objectives with the so-called duplex fronts, but others; and I may add, not merely objectives of American make, but some constructed by a well-known English house. As might be expected, the quality of the image formed by the direct rays of the sun thrown through a pin-hole at this excessive obliquity varies very greatly in different cases. I will state, however, that I have thus far found at least seven objectives, some of English, others of American make, which define sufficiently well under these circumstances to resolve *amphipleura pellucida* mounted in Canadian balsam. With the objectives which performed best, the field was of exceeding whiteness and brilliancy, but by no means dazzling, the frustule undistorted, and the striæ clean and black on the white ground, very little color-aberration being perceived. With other objectives there was more or less color-aberration and distortion, both which faults were in one or two cases very conspicuous, although, in the part of the frustule most sharply focussed upon, the striæ were handsomely brought out. The objectives with which I thus succeeded, ranged all the way from a $\frac{1}{4}$ to $\frac{1}{8}$ immersion. I will add that the objectives which resolved *amphipleura pellucida* under these trying circumstances, when used in the ordinary way with this or other test-objects, displayed an exquisite perfection of definition which it would be hopeless to expect to attain with objectives of less angular aperture.

As it is no part of my purpose in this communication to provoke ill-tempered discussion of the merits of individual makers, I will not append a list of the results obtained with the various immersion objectives I have tried in this

* Read before the British Association.

* A paper read before the Royal Microscopical Society, June 6, 1877.

† June, 1873, p. 293; November, 1873, p. 210; March, 1874, p. 119; September, 1874, p. 134.

* The apparatus can be used, of course, to secure black-ground illumination of suitable dry objects if they are mounted on the slide instead of the cover, as is usual.

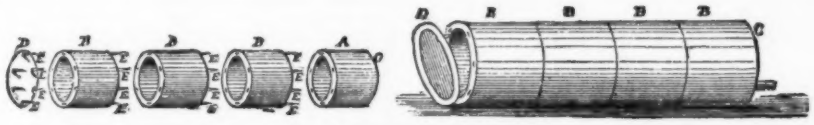
way. The apparatus can be constructed for a few shillings, and those who take the trouble to use it will soon see to which of the three classes any particular objective they may test belongs.

AN ANCIENT BEEHIVE.

WE have been fortunate in obtaining the figure and description of an ancient hive which had this grand object in view—and we give an account which we expect will prove as instructive as it is interesting. The description, with figure, is to be found in two letters (one originally written in English, the other translated from the German) printed during the reign of the Protector Cromwell—more than 200 years ago—and of which copies are preserved in a volume of pamphlets in the British Museum.

The letter from the German professes to communicate "a secret for the better ordering and preserving of bees practised beyond the seas," and the writer thereof, after saying that in his way all occasion of swarming, and the breeding of new master bees or generals is prevented, and that he could, without killing any of his bees, share their honey, proceeds:

"My beehives did not stand upright after the usual manner, but lay upon two long poles or rails within my house, in a garret, close under the roof, where the bees could creep in and out under the tiles. The close end of the hive touched the tiles of the roof. In the upper end of each hive I did cut a hole for the bees to go in and out. The wind end of the hive commonly stands clapt down upon some plank, but



AN ANCIENT BEEHIVE.

"A, a common beehive; B, a prolonger, to lengthen or eke out the Hive withall; C, a hole cut in the upper end of the Hive, A; D, a bottom or dore to shut up the Hive, whether it be single, as A, or lengthened as A B B; E, the wooden pins in B and D for the joyning of them to the ends of A or B."

in mine it was shut up, with a bottom made of straw pinned to it on every side with wooden skewers; and by the like means I could adjoin straw hoops of what breadth I pleased, and so lengthen any of my hives as often as need was, so that they never swarmed, though their number increased so much, that, by several additions, a hive became 2 or 3 yards long. The way of taking the honey from them was this. I unpinned the wide end of a hive, and by burning linen rags, I smoked up the bees thence to the close end of the hive, and then I might easily take away the prolongers, or additional hoops, one after another, till I thought the bees could not spare any more honey."

With the second letter in English there is a drawing (of which a tracing is given) of the hive, or "description of my long beehives expressed in picture, wherein A is a common beehive, not standing as the usual manner is, but laid along upon one side. In the upper part of the hive I cut a round or four-corned hole, through which the bees may pass in and out, here marked C. In the placing of the hive you may turn that hole downwards if you will; but I turn it always upward, that the bees, when they are laden, may rather go downward than upward.

"Besides, if I turn it upwards, I cannot well set it close to any hole left for the bees' entrance under the tiles in the roof of a garret, which is a far surer way than, after the usual manner, to leave them in a garden, exposed to thieves, vermin, and distemper of weather.

"Where the roof is inconvenient, I used to make a hole in the upright wall of a garret, and set the hives close up against the wall, with a hole in its head precisely answering to that hole in the wall. The open end I shut up with a bottom made of straw, as you see represented at D, which may be opened easily and shut close and firm by the help of those wooden pins here marked with E. When I perceive that my bees have near filled their hives I take off that shutter, D, and set on a prolonger like the hive, but that it hath no head such as here marked with B, and then shut up as before with that straw door, D. Thus I may add as many continuators as I please shutting close up to one another, always closing the last with D. Whensoever I intend to take some honey from the bees I provide linen rags wherewith I make a smoke, and let it into the hive by pulling away the door, D, from whence the bees are driven by the smoke towards their small entrance, C, so that I may safely take away as many prolongers as I think good, and put a fresh one in the place, shutting it up with the door, D."—*Agricultural Gazette.*

THE RAMIE FIBER.

M. AUBRY LECOMTE, who is connected with the French Government, says that the ramie has occupied the attention of the officers of the Permanent Exhibition of Colonial Products, held in a portion of the upper floor of the Palais de l'Industrie, for the last ten years, that plants and instructions for their cultivation have been sent to the authorities in all French possessions within the tropics, and that the new textile plant is now perfectly naturalized, especially in Guiana, Bourbon, Guadeloupe, Senegal and Cochin China, and promises to play a leading part in colonial agriculture, a fact which cannot fail to interest Englishmen.

It should be mentioned at once that the ramie or ramié, as some write it, is called by various names. M. Aubry Lecomte calls it *urtica tenacissima;* another, whom we shall quote presently, *boehmeria utilis* or *tenacissima*, while M. Leger, to whom we referred in our June number, calls it *candicans*, a native of China, or *urtica viridis*, originally of Java.

The retting of ramie presents great difficulties, the fermentation is easy. The first problem that had to be solved, then, was the construction of machines for separating the fibers, which should act either on the stalks freshly cut, or dry. It was a long time before this was achieved. At first the plant was treated green, but the waste was great, and the product contained 33 per cent. of gum, the first machine having been invented by M. Poland for the purpose. Some time later the same engineer, working with M. Aubry Lecomte, produced another to work the dry stems. This machine is not regarded as perfect, but it is simple, easily worked by one man, costs only £60, and produces six to eight kilogrammes of the rough fiber, or hard, not containing more than 8 per cent. of gummy matter. It has, however, to be used with caution; it is not effective on stems when too woody, and will not act on many at a time. These machines are used advantageously at Mauritius, but it is not stated whether the fiber is grown there as well as in the neighboring island of Bourbon.

The culture of the ramie costs little labor, and when once the plantation is well established the plant kills all noxious weeds; the stalks are cut off as close to the ground as possible, when they have reached a maximum length of 1m. 20c. to 1m. 30c., or 41 to 42 inches English. It is found that at this stage of its growth, the ramie yields the largest amount of fiber. No other treatment is required but to spread the ashes of the burnt waste upon the land. With respect to the crops, says M. Aubry Lecomte, they differ largely according to the nature of the soil, heat, moisture, and other circumstances. At Senegal, for example, only two crops are obtained per year, under the best circumstances, while the Antilles and Bourbon yield four, Guiana five, and Mayotte six. As to yield, it varies from 500 to 1,000 kilogrammes per hectare, or 450 to 900 lbs. per acre of prepared fiber.

The value of the harl prepared by this machine only is about 90 centimes per kilogramme, but by a slight retting, in which there is no danger, it becomes worth 1f. 30c., and there is, further, a saving in freight, and of the cost of further preparation in Europe.

The ramie fiber, bleached by methods in use in England, is remarkable for its brilliancy; combed with care, or cottonized, it is silk to the touch and to the eye, but when spun the yarn has the appearance of wool; the tissue woven from it, when dressed, is excellent as regards evenness and solidity, but the color is that of unbleached linen.

It follows that it is quite useless to bleach the fiber before spinning, and it is best perhaps bleached after being woven. This opinion was given in 1867 by M. Verdure, spinner, of Lille, and it has been confirmed, since the tissues bleached after being woven are incomparable for brilliancy and strength. Many spinners have taken up the ramie; amongst others, M. Verdure, M. Forey, of Essoune, M. Tazenas du Moncel, of Saint Etienne, and the Comptoir de l'Industrie Linière, have given important orders to the officials of the Colonial Exhibition. At Marseilles, M. le Directeur Granguard has established works for the cottonization of ramie, and also for retting. Applications for information reach us daily from Holland, Italy and Spain.

Another writer, M. Ollivier, recommends the ramie strongly as a substitute for the sugar-cane in the Colonies, especially on the grounds that it does not require any extensive works or plant. He refers those interested in the subject to the *Description et Culture de l' Ortie de Chine*, by Ramon de la Sagra; Dr. Forbes Watson's *Report on the Preparation and Use of Rhea Fibre* (Allen & Co., London, 1875); and the *Journal de l' Agriculture Pratique* (February 24th and March 21st, Paris, 1877).

M. Ollivier says that the plant is perennial, and will last from fifteen to twenty years on the same soil. The plants are set about a meter apart in both directions. In the early months the plantation is weeded, and when cut the ramie is left on the ground till dry. As regards number of crops and yield he agrees with M. Aubry Lecomte. Supposing three crops a year, and taking the value at 90c. per kilog., the profit appears to be upward of 2,000 francs per hectare, which is more than the sugar-cane will yield. The first year only gives a half average crop, but the second a full one.

Plants are to be obtained at about a penny each, and about 4,000 are required per acre, and from each acre three may be planted in the second year.

M. Ollivier says that the machine referred to above has been purchased by the French Government, and sent out to Guiana, Guadaloupe, Bourbon, and Cochin China; and he adds that, in consequence of the success attained, all the French colonies have undertaken the cultivation on a considerable scale, and the retted fiber finds a market in England at 80 or 90c. per kilogramme.

The prospect thus laid open is highly attractive. But M. Ollivier is sanguine of a new method of treatment commenced by M. Verdure de Bethume. Heretofore the ramie has been cottonized, but M. Ollivier naturally objects that such treatment shortens and misapplies the fiber; "but," he adds, "the system has been transformed, and the English, while submitting it to cottonization—that is to say, to complete disaggregation and bleaching—work it on silk-spinning machinery, and produce yarn, which is used in England and France in mixed woolens and silk stuffs, trimmings and mohair.

M. Verdure proceeds by simple retting: and this, of course, preserves the long fiber peculiar to flax, hemp, etc. and retains all its natural strength, elasticity, durable qualities and brilliancy. A grand point in M. Verdure's process, as stated, is that when combed his fiber gives double or nearly double as much yarn as when cottonized, while it can be employed in any tissue just like cotton or silk flax, and with it new kinds of tissues may be produced which neither cotton nor flax will make. M. Verdure has dyed the fabrics made from ramie, and it is said that the black and other colors obtained are quite equal to those on flax.

DEATH BED STUDIES.

IN a recent number of the *New Quarterly Review* is an article on "The Riddle of Death," by Francis Power Cobbe. The author, confining the inquiry to those cases where the bodily conditions do not apparently interfere with the perfect sanity of the patient up to the moment of dissolution, asks whether in such cases instances have ever been known of occurrences having any significance, taken in connection with the solemn event wherewith they are associated? In answer to this a number of examples are cited, in which persons dying in all apparent sanity have shown unmistakably, by their gestures, and sometimes by their words, that they saw in the moment of dissolution what could not be seen by those around them.

This observation we believe to be well founded. The instances cited, though not reported with precision, are, no doubt, in the main, true. Moreover, we can recall in our own experience, to have personally known instances where the words, the gestures, and still more, a very marked and remarkable change of expression in the features of the dying, proved beyond doubt that they experienced within the last few minutes or seconds of life a train of emotions wholly different from what they had recently been manifesting. We lay particular stress upon the alteration in the expression; for when the individual is too far gone to speak, let alone to make a gesture, the involuntary reflex nervous action continues to indicate, in a manner that admits of no doubt, the mental action still going on.

But the interpretation of these acts may not be that suggested by the writer above quoted—to wit, that it is a glimpse of the world beyond, the immaterial form of existence, which meets the dying eye and lights it momentarily with ineffable joy, or appals it with a nameless terror.

The inexorable principle of science, the first law of reasoning on facts, bids us, in all cases, assume the *simplest* explanation of a physical phenomenon to be the true one. And these purely physical facts we have been speaking of may readily enough be explained as the manifestation of a momentary delirium which precedes dissolution, finding its proximate cause in the cessation of cerebral nutrition, its complexion partly in the nature of the disease or injury which brings about death, partly in the general previous thoughts and habits of the individual.

Physicians are well aware that the behavior of men when death is imminent, though partly governed by what we call courage or fortitude, is also largely affected by other causes—as by their convictions regarding a future state, by their existing social relations, and by the character of disease or injury with which they are suffering. Persons who enjoy happy surroundings and pleasant domestic and social relations are influenced—by a strong love of life, rather than a fear of death—to wish to stay. Where the reverse is the case, death has not only no terrors, but is often sought as a relief. The religious views which persons entertain have also considerable influence, though it is constantly witnessed that some devout religionists betray excessive trepidation at the approach of death, and others extreme exaltation; while as many professed anti-religionists pass through their last hour with calm serenity, as with remorse. That the conduct of eminent teachers and philosophers on their death-beds should ever have been adduced, *pro* or *con*, as testimony in regard to their doctrines, is a singular absurdity. It makes no difference what a man believes, so that he believes it firmly, so far as its effect at such a time is concerned.

The immediate cause of the death has much to do with its character. In some diseases, as in cholera, patients commonly manifest but little concern as to their fate. In the surgical history of our late war it is observed that wounds of the chest and abdomen are usually accompanied by great agitation, alarm and anxiety, overcoming the valor of the bravest soldier. In other terrible wounds, as when the limbs are torn off, or when the sympathetic system is overwhelmed, a perfect calmness and serene consciousness are present—a symptom far more ominous to the experienced surgeon than the trepidation just mentioned. It has been remarked that those dying from sword wounds have a languid, resigned aspect, while those killed by shot present a firm, defiant expression. It is probable that these differences, though, no doubt, indicative of the emotions of the last moment of life, yet depend a good deal on the structure implicated, and are modified, as the mortal wound affects the nervous, circulatory or respiratory system. In the same manner, as death from disease begins at the head, the heart or the lungs, we may suppose a corresponding difference in sensation takes place, which will be manifested on the facial muscles.

More extraordinary than this, to our mind, is the occasional sudden return to sanity, for a few hours before death, of the chronic insane, even of those who for many years have been considered hopelessly impaired in cerebral structure. And most remarkable of all are those instances—few in number, it is true, but one of which we were personally cognizant of—where very aged people, after years of utter senility, for a few minutes or for an hour or two before death, regain their mental power, their memory of events, and the acuteness of their senses.

As to the inquiry which we started by quoting, the medical man is obliged to encourage strong doubts whether the death change referred to can be attributed to any causes dissimilar from those above mentioned; however glad he would be able to contribute, from his necessarily extensive observation of the close of mortal life, some facts which would throw light on what comes thereafter, it is noticeable that in no physiologies or monographs, such as the classical one of Bichat, is there any hint or suggestion that the study of the phenomena of Life teaches us what, if anything, is written on the blank page of Death.—*Med. and Surg. Reporter.*

ON THE FLUID EXTRACT OF JABORANDI.

By FRANCIS V. GREENE, M.D., U. S. N.

Take of jaborandi leaves, in moderately fine powder....	16 troy ounces.
Alcohol (50 per cent.),.....	a sufficient quantity.

Moisten the powder thoroughly with the menstruum, pack in a conical glass percolator, place a layer of two inches of well washed sand on the top of the cloth covering the material, add menstruum until the liquid begins to drop from the percolator, when the lower orifice is to be closed with a cork, and the percolator, securely covered, set aside in a moderately warm place for four days. At the expiration of this time remove the cork, and add more menstruum by degrees until the material is exhausted. The first fourteen ounces of percolate are to be reserved, and the remainder evaporated on a water bath, with constant stirring towards the close, to two fluid ounces, which are to be added to the reserved portion. If the percolation and evaporation have been properly performed, the fluid extract will not require to be filtered.

As the use of sand in the manner mentioned above appears to be called for theoretically in the case of a material like jaborandi, for the reason that in furnishing the required pressure, it secures the uniform distribution of the menstruum from the surface of the material through the whole extent of the mass, which point constitutes the essence of the process of displacement, its employment might be very advantageously extended to the percolation of various other substances, where difficulty of a similar nature is experienced.

INFLUENZA affords a familiar example of an epidemic disease, a whole community being often attacked in the course of a few hours. From this it may be inferred that the occurrence of this disease is connected with some particular condition of the atmosphere, but what that condition is, is not yet known to science.

THE FILLING OF WAFER CAPSULES.

By J. C. Wharton.

The introduction of "wafer capsules" or "cachets de pain" may be regarded as a permanent and valuable addition to the art of pharmacy, and must meet with extended favor among the three classes of persons intended to be benefitted by them. By these classes are meant physicians, patients and pharmacists.

When first brought to notice in this section, their novelty created an unusual, perhaps an undue demand, and subsequently a very natural wane in popularity was manifest; but they are still prescribed, and fill a place that nothing else does so well.

It is often desirable to put up in them comparatively large amounts of medicine, and to have them in as small wafers as possible. In fact, a pharmacist may gain some credit, both with physician and patient, by using the smallest size of wafers possible. I therefore write the present communication to indicate a method which, I think, will aid others, as it has done in some cases already when the plan was adopted. It is not an easy matter to *pour* a large amount of medicine in the center of the wafer off of the end of a spatula or out of a piece of creased paper, as is often attempted, especially if the wafer is small. The consequence is that a larger size than necessary is frequently taken.

I think it worth while to state that an easy and sure method of filling them to their *utmost capacity* is, first to put the medicine into a small *cone* of paper or thin metal, and then compress the powder or other medicine slightly with the end of the finger or in any other convenient way, and afterward to invert the cone over the wafer and gently tap it if necessary, when on removing the cone the medicine will generally be found centrally located in the wafer, and nothing remain to be done but to cover it with another similar wafer, previously moistened, and finally compress the edges together. If the cone is short in proportion to the diameter of its base, the powder may be too easily dislodged and may be scattered over too much surface of the wafer. In such case the wafer may be placed on the cone before it is inverted, so as to invert both wafer and cone in one act, and thus confine the powder within the limits of the base of the cone. A little practice will insure quite a gratifying success.

It is scarcely worth telling many pharmacists that a cone can be made on paper in about two minutes by taking a round label or other paper, which should be glazed and of about one and a quarter inch diameter, cutting it in half and pasting along the straight edge or diameter of one-half, and folding it into a cone over the end of the finger, so that the straight edge shall form the junction or seam, and the paste will cause it to unite. By holding the seam together and gently warming it, the cone will soon be finished. A small wooden handle may be attached by thrusting it through the point of the cone and pasting it to the paper.

In filling the cone with the medicine, I think the best way is to press the edge of it against the tile or slab just by the powder, flattening the rim of the cone by gentle pressure, and forcing the powder into the cone with the spatula held edgewise against the slab. After the powder is in its place a gentle pressure upon it with the finger, as before stated, will be of service in keeping it together and causing it to come out as if moulded to the form of the cone. In many cases, also, the cone will retain the powder sufficiently well to be inverted without dropping it until gently tapped. —*Amer. Jour. of Pharmacy.*

RESEARCHES ON THE CONSUMPTION OF OXYGEN AND THE EXCRETION OF CARBONIC ACID IN MAN.

By Dr. Speck.

The author has examined the changes produced in the respiratory process by the use of a fatty food, of coffee, quinine, alcohol, and water, and by the inspiration of air respectively rich in carbonic acid, poor in oxygen, and rich in oxygen. His chief conclusions are: (1) With an increased proportion of hydrogen in diet the amount of the air inspired and expired decreases. Nutriments, such as sugar, which contain little hydrogen in comparison with their oxygen, involve more exertion of the respiratory organs than such as are rich in hydrogen, like the fats. (2) The more carbon predominates in the food in proportion to hydrogen, the more air is exhaled in proportion to that inhaled. (3) The more carbon increases in the diet in proportion to hydrogen, the more carbonic acid is evolved and the more oxygen taken up; the richer the diet in hydrogen, the less oxygen is required. An atmosphere containing 5 or 6 per cent. of carbonic acid could be breathed for some minutes without oppression. At 11·51 per cent. great exertion was needed to breathe for 1 minute. At 7·2 per cent. all the carbonic acid produced in the body is retained in the blood, and at 11·2 per cent. a great part of that also which is inhaled.

Decrease of Lime in the Body, and especially in the Bones, with Deficient Ingestion of Lime.—Dr. J. Foster.—If in a diet, ample as regards the constituents of the albuminoids, lime is insufficient, the muscles and also the skeleton show a deficiency in this earth.

INSECTS IN FLOUR.

To discover whether there are acarians in a given specimen of flour, M. Troupeau recommends to place some of the flour between two sheets of paper, and thin it out by pressure with the finger. If acarians are present they soon reveal their presence by presenting small molecules, visible to the naked eye. You then transfer these, by means of a moistened point, to the stage of the microscope. To study the legs and hairs of acarians it is indispensable to use a mixture of glycerine and acetic acid, which increases the transparence. To avoid bruising the insect a hair should be placed between the plate and the cover-glass. Examining in this way a number of specimens of flour, of various source and age, M. Troupeau has found that nearly all have contained acarians, and these animals are more numerous the longer they have been exposed to action of air and moisture.

THE POISON OF SMALL-POX.

In the session of the French Academy of April 30th, Messrs. Pasteur & Joubert made an important communication on the nature of the poison of small-pox (hœmorrhagic variety). They have succeeded in propagating the bacteria, which are contained in the blood during this disease, outside of the living organism, in "dead" liquids; and they found that their vitality remained unimpaired, even after repeated transplantation. Such an infected solution may be filtered by means of appropriate apparatus, and completely freed from bacteria, so as to become entirely inert. During the artificial propagation of these bacteria in clear solutions, no microscopic granulations appear to be formed; at least, even under the most powerful lens, no organized or amorphous substances can be traced outside of the bacteria. These facts make it highly probable that the poison of small-pox is a bacterion, and not a virus.—*Ber. d. Deutsch Ch. G.*, 1877.

FRESH MEAT TRANSPORTATION.

The ship Frigorifique from the River Plate, South America, with a cargo of meat in good condition, lately arrived at Havre, 112 days having elapsed since it was loaded. At Rio de Janeiro, 30 days out, her cargo was examined and found sound; also at the Cape de Verde Islands. This is her second voyage, and she is proved to be a great success. The system of the Frigorifique is entirely dissimilar to the system used by the exporters from this country, that neither ice, salt, nor saltpetre is used. The air is purified and dried by a different process without the use of ice. The machine will run for 3 years without being recharged.

The Cold Storage Wharf, limited, of London, has an area of 220,000 superficial feet, divided into 12 compartments and fitted up at an expense of £8,000, with Mr. D. Toilerman as manager, with a capital of £100,000, and the Fresh and Preserved Meat Co., limited, of London, Mr. James Bruce, manager, with £150,000 sterling capital, invite consignments of fresh beef, pork, mutton, game, poultry, eggs, butter and cheese, fruit, shell fish, etc., which will be sold in their various departments.

[Harper's Magazine.]

AMERICAN WORKMEN FROM A EUROPEAN POINT OF VIEW.

It was a matter to stir one's patriotic pride, but not less to move one's pity, to observe the commotion in business circles in Switzerland, as the reports of the Swiss Commissioners to the Philadelphia Exhibition were made public. Affairs were not in a cheerful state at the time. The "hard times" that had begun in America were already sorely felt in the centre of Europe. Production was slackened in all the factories, and the values of many favorite investments had shrunk to one-half. When the report of M. Favre Perret on American watch-making was read to crowded meetings of watchmakers at Neuchâtel and Geneva, the general expression was that of abject despair. Work was suspended for months on the costly building of the School of Watch-making founded by the Geneva government. A commission was appointed by the cantonal legislature to enquire what new industry could be introduced in place of that which must henceforth be abandoned to American competitors.

Among those interested on the other leading manufacture of Switzerland—the silk factories of Basle and Zurich—there were like searchings of heart. This same report of M. Favre-Perret warned his fellow-citizens that the silk business was as sure to be run away with by the Yankees as the watch business. The wonder in both cases is that facts which had so long been accumulating, and which had never been hid in a corner, should have taken any body by surprise. The exportation of ribbons from Basle to the United States has been dwindling regularly, and is now reduced to one-sixth of what it was only four years ago. It is obvious that the next step for the Americans, after supplying their own market, is to compete in other markets.

The productions of the Swiss dairies are prized in all the markets of Europe. Last January, M. Grenier, at a meeting of the Agricultural Society of the Canton de Vaud, informed his associates to what extent the dairy productions of the great establishments of the Northern States and Canada were overflowing the home market. "There are thousands of these establishments," he said, "with capital amounting to $25,000,000, already producing to the amount of $31,000,000 annually. The export of cheese was 38,000,000 pounds in 1863, and 96,000,000 pounds in 1874. The export of butter has grown to 52,000,000 pounds a year. The competition is getting formidable, for the manufacture of cheese has been so perfected in America that, unless we look out, it will become utterly impossible for us to compete with it."*

A very large dealer in leather, M. Bally, declares that the same is true of this article. "Europeans no longer control the leather market. Prices are now set by America. Every little tannery feels the influence of the importations from America; our own exportation to the New World has dwindled almost to nothing."

At first thought it was supposed that the superior advantages of the American manufacturer arose from his use of machinery for operations that continue in the Old World to be wrought out by hand-work. If this were all, or nearly all, it would be an easy matter to import or to imitate the machinery—there are no patent laws in Switzerland—and, by combining capital in great establishments, to go on with their business with the double advantage of the low wages and abundant skilled labor of the Old World and the organization and appliances of the New.

One eminent American house, however, with ample capital, had made this hopeful but expensive experiment. The finest business edifice in Geneva was built, three or four years ago, by Americans, and stocked with the best American watch-making machinery. The most skillful Geneva watch-makers were sought for at high wages—high, that is, for Switzerland, but low for America—and the world looked for a splendid success. But the beautiful building is now let out in lodgings, and the machines are advertised for sale. Evidently the secret of American success lay in something else.

I have followed the conjectures and proposals of the Swiss newspapers on this point with great interest. They demand patent laws for the encouragement of invention, schools of technical instruction for artisans, relief from the interruption of work by militia service, and other governmental palliatives; but they do not touch the main point of the superiority of the American manufactories, and that is *the personal superiority of the American workman.*

The secret is revealed in the extraordinary pamphlet by M. Bally, whom we have already quoted, and who is the proprietor of the great boot and shoe factory at Schoenenwerth, in German Switzerland. The pamphlet is printed both in German and in French, and has made a profound impression abroad. It gives, I will not say the impressions, but the shrewd and careful observations, of a practical man on his visit to the United States during the Centennial year. The title is sensational—*Garde à Vous!* ("Look out for Yourselves"—but the matter of it is solid.

Our traveller's first wonder in America is to see *how much is made of a man*, in a business point of view. He gets into a stage on Broadway, "the most crowded thoroughfare in the world," and is struck by the contrivance of fare box and door strap, which enables one man to do the business of three on a Paris line. In a horse car he admires the bell-punch, which saves the company the salary of a *contrôleur*, and does the work more effectually. On a railroad train he is amazed to find only one conductor, and nothing of the army of watchmen who on European roads stand guard at every curve and crossing. He recalls the starting of a Swiss train: each one of a series of conductors cries successively, "Fertig!" then the *chef de train* calls, "Fort!" then he whistles; then the bell rings; then the locomotive whistles; finally the train starts. In America, the conductor surveys the whole train. When all is ready, he makes a sign to the engineer, and off she goes. It is the traveller's business to know the time of starting, and if he gets left once, he is likely to take better care another time.

All this by way of showing how, everywhere in America, each man's labor is made to go as far as possible. You find the same distinction between the manufactories of the Old World and those of the New. "In Europe, as business increases, the proprietor enlarges his establishment; in dull times he contracts it. When competition compels, he improves his machinery, so far as he is driven to. If wages are too high, he moves his concern into the country, or to some region where manufactures do not abound. The American pursues another course. He contrives to increase the amount of production. His question is how to get the utmost out of his hands and his machinery. He does not delay improving his tools until he is driven to it, if the improvement is going to save time and money. If wages are high, he compensates himself by means of improved arrangements. It is not the mere machine that gives the American his advantage both in quantity and in quality, it is the way he uses it."

Naturally our traveller is interested in the oil regions, from which half the homes in Switzerland are lighted. He finds the system by which the petroleum is delivered directly from the well to the tanks at the railroads by means of conduits, to be characteristically American. "Among us for years and years the petroleum would have continued to be dragged to the railroad by peasants with their oxen, before it would have been decided to lay the pipes."

Not to dwell too long upon the details in which M. Bally delights, and which give great value to his pamphlet, we may quote some of his descriptions of particular establishments:

"To give a more exact idea of American methods, let me introduce you to the printing-house of —— and ——, at New York, one of the largest in the world. One day as I was walking in 'the Swamp' with two of my friends, I was struck by the immense building, and without knowing what it was, I proposed to my friends to take them into it. A few steps further we met a tanner, who gave me a friendly salutation, reminding me that he had been introduced to me a few days before. I asked him what that remarkable building was; he at once offered to show us over it, although he did not know any one in the concern any more than we did. They gave us a guide at the counting-room, who showed us everything. On the ground-floor are the newspaper presses, working upon stereotype plates; they deliver two copies a second of a newspaper, printed on both sides. We have similar presses in Europe, to be sure, for the great journals of England and France; we are acquainted also with the folding-machine, which takes the flat sheet, and in one second gives it back as a folded newspaper; but you would hardly find among us such work-women as we saw here, who fold three sheets a second. We asked them, for fun, whether they couldn't work faster than that; and they answered, quite in earnest, 'Not in nice work, but in common work we can.'

"In the artistic department, devoted to wood-engraving, the arrangements are similar to those of European establishments, but I feel bound to say that in the American journals the printing and illustrations are handsomer than with us."

But the most instructive part of M. Bally's testimony is that which relates to his own line of business—the shoe manufacture. The reader will not be surprised to find that he is in advance of his fellow-countrymen, and that his own establishment at Schoenenwerth is organized, as nearly as the case admits, on the American system. This gives great value to his observations on the points of difference that still remain between his factory and one in America. The factory which he visits, in company with the chief proprietor, is in a Massachusetts country town:

"After a longish trip by railroad, we arrived, feeling thirsty with the tropical heat. The proprietor invited me to dinner at the best hotel of the little town, which had been built by himself. At table he asked me what I would drink. There was neither wine, beer, nor any spirituous liquor to be had in the hotel, nor even in the town. I was not embarrassed, and called for cold tea, for the same thing had occurred to me before, especially on one occasion four years before. That time a friend had asked me to spend three days with him, from Saturday till Monday, at Stoneham, and it was impossible to find in the whole town a drop of the juice of the vine—even of the hop vine.... A thorough exploration of the factory brought us first to the department where the leather is prepared for the soles. Five stamping-machines furnish all the soles required for a maximum production of 9000 pair a day. At my factory one machine of the same sort can not turn out more than 500 pair of soles a day.

"In this department, as well as in that for cutting the uppers, it is a settled principle to employ none but American workmen. The men are paid by the day; but an account is kept with each, in which he is debited with the amount of leather delivered to him, and credited with the amount of work which he accomplishes. If he falls short of a certain amount of work, or if he wastes too much stock, he is discharged. In shops of the same dimensions with mine, they turn out six times the amount of work. But it should be remarked that in America each manufacturing concern devotes itself to a specialty, while the European houses are under the necessity of executing more or less everything in their general line of business.

"With us, for the 'crimping' of boots the workmen is paid about fifty centimes (ten cents) a pair. In this American factory, by means of a crimping-machine and a little stretching apparatus, one man can crimp a pair in eight

*I quote the extract from a published paper by M. Edouard Dubied, of Neuchatel, translating kilograms into pounds at the rate of one to two, and francs into dollars at the rate of five to one. M. Dubied sums up a series of statements by saying: "At this rate, there is no one of our industries which is not in a fair way to be overwhelmed by American competition.

minutes. By reckoning what we ordinarily pay for a day's work, it is easy to calculate how much quicker the American works than the European. To crimp 3000 pair of boots a day, like the concern of which I am speaking, we should have to keep, with our present methods, not less than 200 workmen for this alone.

"In the sewing shop the feed of the sewing-machine communicates with a pedal. The thread cuts itself the moment the right hand takes away one shoe upper or boot leg, while the left hand brings on the next, the foot still resting on the pedal. So the machine keeps sewing for hours, without cessation, at the rate of 800 stitches a minute.

"The eyelet machine, of which I brought a model home with me, cuts the hole and sets the eyelet at the rate of 175 in a minute.

"With the pegging-machine I have seen, in one minute, two pairs of soles pegged to large men's shoes with a double row of pegs. In this space of time, then, the machine has driven 800 pegs, without allowing for the time of fixing the four shoes to the machine and taking them off.

"With us, it takes not less than an hour for a country shoe-maker to finish and polish a pair of common workingmen's shoes. In this factory, the seven different operations that go to this work are easily dispatched in ten minutes...

"The proprietor complained of the high rate of wages. He could not get hands at less than two dollars a day; and so long as this continued, he could not think of doing an export business. I footed up, from his own factory books, the amount he was paying *by the piece*, and found that I was paying double what he was, and yet my men are always grumbling. They work with American machines, and use the same sort of tools, but they are far inferior to the Americans in productive capacity. The same remark has been made by manufacturers who have set up German shoe factories on the American plan, but find that they can not succeed with German workmen."

Another trait of American manufacture is the elasticity with which it accommodates itself to fluctuations in the market, and this also, according to our author, is to be ascribed largely to the character of the workmen:

"I am almost ready to say that the proprietor has only to accelerate or retard the movement of his steam-engine, to get from his hands a proportionately greater or less amount of work. This elasticity extends even to the little workshops. The tools and machines of the small manufacturers are of such a sort that their owners are not so dependent on their hands as they would be among us, where one is often unable to deliver goods at the time agreed upon, because one of his men has been to a wedding, or has been sick, or has gone off suddenly without giving notice. It takes very little apprenticeship to give another man the run of the work, even though he may not have been trained to that line of business; he fills the vacant place, and the employer is saved from embarrassment. The result of this is that manufacturers on a small scale can and do take responsible contracts for work to be delivered at a fixed time. With us, on the other hand, the small employer, instead of exerting himself to attain this result, drifts away from it more and more, and makes up his mind calmly to the deplorable state of things which, to the misery of the public, seems to have become incorporated into the public morals. Our artisans freely undertake to deliver work at a fixed time, and will give all manner of *oral* assurances of punctuality; but woe to the man who trusts to any thing short of a written contract, with a stipulation for indemnity in case of failure; he will find no end of unforeseen circumstances hindering. Instead of reducing such hindrances to the category of exceptions, they have become the rule to such an extent that, even when they do not exist, the contractor thinks it best to mention them by way of apology. I am sure that an American would blush to tell his customer that the prompt delivery of work according to engagement was impossible because one of his workmen had got married. In any case, he would be sure to lose his customers as soon as it appeared that his word was not to be relied on.

"One thing that astonishes a European when he arrives at an American hotel and gives his linen to be washed, is to have it promised back for the next day, be it much or little, and at the hour named to find it in his room in perfect condition. But in America you may trust any artisan as implicitly as you do the washer-woman. No matter how perfect a man's tools may be or how neat his workmanship, he will get no business if he falls into the European practice on this point."

What are the old countries to do to meet this formidable danger of American competition? The study of the Continental European press on this subject for the last six months has been full of interest.

Not to dwell upon the various remedies, inappropriate or inadequate to the case, that have been proposed—protective tariff, improvement of machinery, technical schools, patent laws, creation of new industries, not yet liable to American competition—let us advert to those which come to the main point of the trouble, and look toward advancing the character and effectiveness of the European workman.

"So long as the aim of the artisan is to extort from his employer high wages for inferior work, and so long as the existing indifference regarding quality of work continues to prevail, there is no hope for the revival of our manufactures. America has nothing to fear from such competition as this." Thus M. Bally, recommending that measures be taken to bring the workman to a good understanding for the common advantage. No one will doubt the importance of it—if practicable. The folly of the mobs that broke the spinning-jennies is not yet obsolete on the continent of Europe; a labor-saving machine is looked upon by the workman as a natural enemy. An important branch of industry—the jewelry manufacture—has been for years banished from Switzerland in consequence of frequent strikes and exorbitant demands for wages. One eminent manufacturer of watches in Geneva gave me as a reason for his abandoning the business, the difficulty of getting honest work done by his own men.

Finally, the measures most gravely and reasonably insisted on may thus be stated in the language of Mr. Bally:

"It is the duty of governments to resist the demoralization of the people, and not to tolerate the invasion of a place by bars and wine shops that devour the people's earnings, train the young men systematically in habits of drunkenness and idleness, and use every expedient to attract customers and induce the largest possible consumption of liquor. . . . . These drinking shops are dens of vice—the gnawing canker of our youth. They make our children lazy, spendthrift, and reckless, and wretched for their whole lives.

"What sort of success can you expect in a business like watchmaking, for instance, which has to be so organized that one man shall take the work from the hand of another, and then pass it on to a third, in steady and exact succession, when one of these keeps his Sunday holiday over into Monday, and Tuesday is laid up with a headache; Wednesday, it is another man's turn for the same; Thursday, a third man leaves on military service; Friday, a fourth has an engagement with a lawyer to settle affairs with a creditor—in short, when work is broken up by endless irregularities?

"The American works like a clock. His soda water and his tea don't give him the headache. He does not brutalize his mind with brandy. He is healthy and contented; his home is pleasant and attractive. Saturday afternoon he has free, and devotes it to getting the house and family ready for Sunday."

The things that "strike a stranger" among us give us an idea where the difference lies between our country and his. And such descriptions as this of the American workingman—his high intelligence, his business integrity and fidelity, his punctual and energetic industry, and his domestic comfort—ought to put to shame and silence the croaking of silly, denationalized tourists who come back to America to complain of the overworked condition of their countrymen, and to wish we could have more holidays, and more light wines, and a more "genial" way of spending evenings in a beer garden, and especially that we could be emancipated from the austerity of the American Sabbath, and learn to spend the day in a sensible fashion—in excursions and picnics, with a ball in the evening. To one who has studiously compared the workingmen of the New World and of the Old, it is obvious that among the causes which have contributed to that personal superiority of the American which is making the manufacturers of all Europe tremble in view of his approaching competition, one of the very foremost is that religious rest on one day in seven, which is the necessary condition of the most effective labor on the other six.

THE MOONS OF MARS.

AT the recent session of the American Association, Nashville, President Newcomb, referring to the discovery made by Professor Hall, said: "In the first place the question which will arise is, why were these satellites of Mars never before seen? The answer is that Mars is now in a better position for being seen; it is nearer the earth than it has before been since the great telescopes of the present day were constructed. The last favorable opportunity occurred in the year 1845, and with the exception of the Rosse telescope there were none such as at present. Another reason no doubt has been that no one ever thought of attesting them. The telescope has been known for two and a half centuries. From the time of Galileo to the present day astronomers have been looking at Mars, and I suppose the idea that it had no satellites had taken possession of astronomers. Again it might be remembered that the discovery of such satellites is a more difficult matter than those who are not astronomers would suppose. You must remember that there is nothing to distinguish a satellite from a distant fixed star. If we had no bodies but those of the solar system to examine, if there were no stars in the heavens, then the discovery of remote bodies in the solar system would be immensely facilitated, because when the astronomer saw one he would know it was some satellite, it was one which he had not before seen. But you have scattered over the heavens a vast number of stars. I believe that the great Washington telescope will show not far from fifty millions. No matter where you point it you will see a large number, and upon a mere inspection it is impossible to distinguish these stars; therefore, the first question that presents itself is whether this is a planet or a star. The only way of telling which it is, is to watch for it some time and measure its distance and find whether it moves or not. If the stars were few in number, of course you would soon find out, but where you have millions it would be almost impossible to discover. Professor Hall on the 11th of August last in looking at Mars noticed quite near it a small star. He measured its distance from the planet and found it only a few seconds. He supposed at first it was a fixed star, thousands of millions further than Mars in the same direction. Then those great enemies of the astronomer, the clouds, came up before he had time to decide. He did not get another view of Mars for five days, and during these five days the planet had moved several degrees. There was no way of telling whether the star was still there or not. It was lost. But in looking again he saw a new star; he measured that, and was enabled on the second evening—which I think was on the 16th of August—to observe it an hour or so. He then found the star following Mars, But he hardly credited that. There must be some mistake in his observations. There was no way of telling whether it was a satellite or an asteroid. He measured it at certain distances, and knew that moreover on the following morning it would be again at the outside of Mars. He would therefore look at Mars the following morning to see if it had not gotten around there. In the first part of the evening it was not to be seen, but at 4 o'clock in the morning it came out, and then there was no doubt whatever. The night following this one it was followed by another much closer to the planet and a little brighter (therefore it must be a second satellite), and on the morning of the 20th of August we were enabled to telegraph to Europe what I think we may fairly regard as the greatest discovery which the telescope has given to astronomy. Now these satellites are remarkable for not simply belonging to the planet nearest the earth, but also remarkable for their small size and rapid motion. This inner satellite of Mars goes around the planet in less than eight hours, while Mars himself revolves in twenty-four hours. The consequence of this is that this satellite rises in the West and sets in the East; that is, the motion of the satellite around the planet towards the East is more rapid than the planet itself, and thus is an exception to any other of the heavenly bodies. If there are any astronomers on the planet Mars that have had to go through the same discoveries with the planets as we have had on the earth, then indeed the satellite must have been the source of very great complication and difficulty. The outer one, notwithstanding its proximity, is so small that it is hardly likely that it would be seen here from the surface of Mars, and would look rather more like the planet Venus than like the moon. To determine the diameter of these satellites is extremely difficult, looking at them with a telescope, and the only way is by judging of the amount of light which they give. It is found by this that the outer satellite gives above one hundred thousandth part as much light as Mars, or perhaps the proportion may be two or three or several thousandths less; therefore, the diameter of Mars must be three or four hundred times the diameter of the satellite. The diameter of Mars is only four thousand miles; divide that by four hundred gives ten miles for the diameter of the satellite, which is probably a good estimate. It may be as small as four or five miles, it can hardly be more than thirty. The inner one is rather brighter than the other and is plainly visible. Its diameter may be not less than ten or as much as forty or fifty. The nearest body to the earth is the moon —140,000 miles. The inner of those two satellites is only 6,000 miles from the center of the planet, and from the circumference of Mars not very much farther than the breadth of the Atlantic. The moon, the nearest of the heavenly bodies, is sixty times as far from us as this satellite is from the inhabitants of Mars."

ECLIPSES OF THE MOON.

THOUGH we are accustomed to speak of a total eclipse of the moon, as is well known, it rarely happens that she disappears while in the earth's shadow. The physical features of interest to which allusion is made above consists chiefly in the variations of the coppery and other tints which spread over her surface, and in the great majority of eclipses render her more or less conspicuously visible, during her passage through the shadow; and as these variable features depend upon the state of the atmosphere at the time round the edge of the earth's disk as seen from the moon, with respect to transparency or more or less prevalence of cloud therein—the aspect which a particular eclipse is likely to present does not admit of prediction. In the eclipse of June 15, 1620, Kepler states that the moon wholly disappeared, while stars of the fifth magnitude were visible in the neighborhood, and Hevelius failed to see her even with a telescope during the eclipse of April 14, 1642 (not April 25, as stated in many astronomical treatises). But perhaps one of the most striking instances of the kind is afforded by the eclipse of May 18, 1761, observed by the Swedish astronomer Wargentin at Stockholm; eleven minutes after the total immersion he could not perceive the slightest trace of the moon either with the naked eye or with the telescope, yet the night was very clear and the stars shining in her vicinity; but about forty minutes later, with a two foot telescope, he discovered our satellite by a faint light on the border of the disk. As an instance of the contrary nature, where the moon has been so strongly illuminated during her presence in the shadow as to admit of the various markings upon her surface being seen with distinctness, and even to lead persons to doubt her being eclipsed, mention may be made of the eclipse on the morning of December 23, 1703, which was observed by various astronomers in the south of France. At Avignon, during the whole duration of the passage through the earth's shadow, "the moon appeared extraordinary illuminated, and of a very bright red, so that it might have been supposed that she was transparent, and that the sun was behind her globe, and that his rays passed through in the same manner that they are slightly diaphanous." It is singular, however, that while this was the aspect of the phenomenon at Avignon, different features should have been noted at Montpellier, particularly the total disappearance of the moon, rather quickly towards 6h. 30m. A.M., though the night was as transparent as could have been wished; it is mentioned that the twilight was already very sensible, but that the invisibility of the moon could not be wholly attributed to this cause, since many stars were shining in the same quarter of the sky. A later instance of the same kind occurred on March 19, 1848, recorded by observers in England, Ireland, and Belgium, when the moon's disk was intensely bright, coppery red. The uninitiated were doubtful of there being any eclipse. It is worthy of mention that conspicuous aurora borealis was present during the night.—*Nature.*

PHOTOGRAPHY OF THE SUN'S ROTATION.

By CAPTAIN ABNEY, F.R.S.*

THOUGH it is now generally admitted that the approach or retrocession of the stars towards our system can be observed by means of the displacement of the absorption lines of their spectra towards the most or least refracted end of the spectrum, yet, in the minds of some, there still exists a lingering doubt of the truth of the process employed. If, however, the displacement of the absorption lines due to the rotation of the sun can be shown to agree with the theory, all doubt must be removed. Huggins, Christie, and Young have proved the solar rotation to their own satisfaction; but with the methods employed there might be some danger that the displacement noted was due to some other cause. I have made some experiments lately in the same direction, which have, I think, been fairly successful in conclusively demonstrating the truth of the problem, which I will describe.

A condenser was prepared by cutting a lens across the center and mounting the two halves side by side, in such a manner that the two images formed by the sun were tangential one to another, the tangent being parallel to the horizon. The light from the sun was thrown into this condensing arrangement by means of a heliostat having a mirror silvered on the surface; and the images were brought to a focus on the slit of a spectroscope, the point of contact of the two suns occupying a position half-way down the slit. To the spectroscopic apparatus was attached a camera and lens of some six or seven feet focal length, and the spectrum was thus formed on a sensitive plate. When the north and south points of the sun's image were tangential, evidently no displacement of the two portions of the spectrum formed by the upper and lower halves of the slit should been seen; whereas, when the equatorial portions of the images were in contact, the displacement of the lines should be that due to double the rotation, since the eastern limb should be receding and the western advancing

Thus, if photographs were taken in the morning, at noon, and in the evening, the apparatus remaining in the same position, it is evident that a displacement of the lines in the top half of the spectrum should first be noted in one direction; next, there should be no displacement of the lines; and, finally, there should be a displacement of the lines in the top spectrum in the reverse direction to that first noted. On the two separate occasions on which I have devoted a day to this subject I have found such to be the case. In the first I was using a refraction apparatus of considerable power; in the second I employed a diffraction grating by Rutherford, of over 17,000 lines to the inch, which Mr. Lockyer kindly placed at my disposal. The fourth order of the spectrum in the last case was employed, and that portion lying about the H lines was taken to test the method. I have not had sufficient time to measure the displacement of the lines, but as far as I have gone, the truth of the method first applied by Huggins to the stars is fully borne out.

NEW MINOR PLANET.—No. 173 of the group of small planets was discovered by M. Borrelly at the observatory of Marseilles on the evening of the 2d inst. At 9h. 0m. m.t., its position was in R.A. 22h. 40m. 30s., N.P.D. 97° 34·8'; diurnal motion in R.A. 26s., in N.P.D., + 8', a tenth magnitude. Though several small planets detected within the last ten years are adrift, it does not appear that the present body can be identical with any one of them.

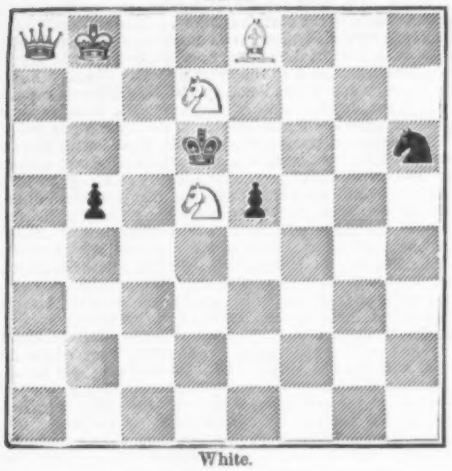
* Read before the British Association in Section A—Mathematical and Physical Science.

SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 19. BY R. H. SEYMOUR.

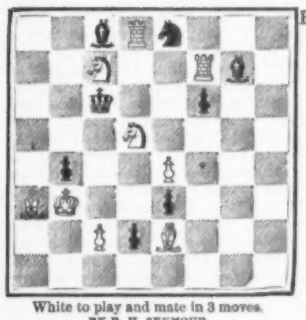
Black.



White.

White to play and mate in three moves.

ROBERT H. SEYMOUR.



White to play and mate in 3 moves.
BY R. H. SEYMOUR.

SELECTING from the recent Problem Tournament of the Hartford *Globe*, the position which received the fourth prize, we present it this week as a specimens of the problematical skill of Mr. Seymour, a rising young composer of this city, whose neat and graceful style of composition has gained for him considerable popularity.

As a chess writer and correspondent, as well as an amateur player of considerable skill, Mr. Seymour has been favorably known for some little time, and specimens of his games have appeared in the leading chess journals; his debut as a problemist, however, is of more recent date, but if he continues to be as prolific as he has been during the past few months, his compositions will soon outnumber us old veterans who commenced during the first half of the present century.

He seems to have devoted considerable time upon the construction of fantastical and curious letter problems, in which peculiar branch he has shown much skill. Our initial letter is one that he contributed to the Centennial Tournament, towards the success of which contest, if we are not mistaken, he contributed upwards of a score of problems.

He is a frequent competitor in our solving tourneys, and has carried off the recent prize of the Dubuque *Chess Journal*, for the greatest number of correct solutions.

We are indebted to Mr. Seymour for the recent invaluable invention of the rubber chess type, which our problemists employ in recording their positions. We find it almost an indispensable article in our editorial capacity.

THE LONDON TOURNAMENT OF 1851.

THIS Tournament, like that of the first American Chess Congress of '57, was arranged upon the plan of pairing off the combatants by lot, the defeated players withdrawing from the tournament. According to the regulations, however, the winner of the grand prize was to hold himself open for forty-eight hours to accept a challenge for a single match with any player of the tournament for one hundred pounds a side. (Mr. Staunton availed himself of this right, and challenged Mr. Anderson, but the match was never played.)

The following list shows the first pairing of the contestants, as well as the names of the victors and the amount of the prizes:

1st Prize,	£183.	Anderson	won against	Kieseritzky.
2d "	55.	Wyvill	"	Lowe.
3d "	37.	Williams	"	Lowenthal.
4th "	27.	Staunton	"	Brodie.
5th "	20.	Szen	"	Newham.
6th "	13.	Cap. Kennedy	"	Mayet.
7th "	9.	Horwitz	"	Bird.
8th "	7.	Mucklow	"	E. S. Kennedy.

At the same meeting there was a similar tournament arranged between provincial players, which resulted as follows:

1st Prize,	£37 10s.	Boden	won against	Angas.
2d "	12.	Ranken	"	Maj. Robertson.
3d "	7 10s.	Hadges	"	Wellman.
4th "	5.	Brien	"	Trelwny.
		Deacon	"	Gilby.

As mementoes of this celebrated meeting we select the decisive game between the winners of the first and second prizes in both tournaments. There were also six set matches between the leading players, with the following results:

Buckle won against Lowenthal; Deacon against Lowe; Lowenthal against Williams; Horwitz against Bird; Staunton against Williams; Staunton against Jaenisch. Many of these were highly important and stubbornly contested matches, and shall be duly chronicled in our department as showing the relative strength of these famous players at that date.

LONDON CHESS TOURNAMENT OF 1851.

ANDERSON.	WYVILL.
WHITE.	BLACK.
1. P to K 4	1. P to Q B 4
2. B to Q B 4	2. P to K 3
3. Kt to Q B 3	3. P to Q R 3
4. P to Q R 4	4. Kt to Q B 3
5. P to Q 3	5. P to K Kt 3
6. K Kt to K 2	6. B to K Kt 2
7. Castles.	7. K Kt to K 2
8. P to K B 4	8. Castles.
9. B to Q 2	9. P to Q 4
10. K B to Q Kt 3	10. Q Kt to Q 5 (*a*)
11. Kt x Kt	11. B x Kt ch
12. K to R sq	12. Q B to Q 3
13. P x Q P	13. K B x Kt
14. B x B	14. P x P
15. Q B to K B 6	15. Q B to K 3
16. P to K B 5 (*b*)	16. B x K B P (*c*)
17. R x B (*d*)	17. P x R
18. Q to K R 5 (*e*)	18. Q to Q 3
19. Q to K R 6	19. Q x B
20. Q x Q, and black resigns.	

NOTES BY MR. STAUNTON.

(*a*) It is clear that he has no better square to retreat to.

(*b*) He would have done much better by playing P to Q 5, forcing the Q Kt to retreat.

(*c*) An excellent move.

(*d*) Mr. Wyvill was manifestly unconscious of the object for which white advanced K B P, or he would certainly have retreated the bishop at this moment, though at the cost of a pawn.

(*e*) This, and the next move of the queen, are part of the combination begun by P to K B 5, and form a beautiful corollary to that well devised sacrifice.

ROBERT H. SEYMOUR.

PROVINCIAL TOURNAMENT OF THE MEETING OF 1851

BODEN.	RANKEN
WHITE.	BLACK.
1. P to K 4	1. P to K 4
2. B to Q B 4	2. B to Q B 4
3. P to Q B 3	3. Kt to Q B 3
4. P to Q 4	4. P x P
5. Kt to K B 3	5. Kt to K B 3
6. P x P	6. B to Q Kt 5 ch
7. B to Q 2	7. B x B ch
8. Q Kt x B	8. P to Q 4
9. P x P	9. K Kt x P
10. Castles (*a*)	10. Castles
11. Kt to K 4	11. Q Kt to K 2
12. Q to Q Kt 3	12. P to Q B 3
13. Q R to Q sq	13. Q Kt to K Kt 3
14. K B x Kt	14. P x K B
15. Q Kt to Q B 3	15. P to Q Kt 3 (*b*)
16. Q x Q P	16. B to K Kt 5
17. Q to K 4	17. P to K B 4
18. Q to Q 3	18. Kt to K R 5
19. K to R sq (*c*)	19. Kt x Kt
20. P x Kt	20. B to K R 6
21. K R to K Kt sq	21. P to K B 5
22. Kt to K 4	22. Q to K R 5
23. Kt to K Kt 5	23. B to K B 4 (*d*)
24. Q to Q B 4 ch	24. K to R sq
25. Kt to K B 7 ch	25. R x Kt
26. Q x R, and black resigns.	

(*a*) Q to her Kt 3 would have been stronger, as it compels black to play Q Kt to K 2.

(*b*) This was an evident oversight.

(*c*) The only move, to all appearances, to prevent serious loss. For suppose now:

18. Q Kt to K 2	18. B x K Kt
19. P x B	13. Q to K Kt 4 ch
20. Kt to K Kt 3	20. P to K B 5, winning a piece.

(*d*) Mr. Rankin's play all through this game was below his customary force. In this case the obvious reply, to avoid the threatened loss of the exchange, was K to R sq.

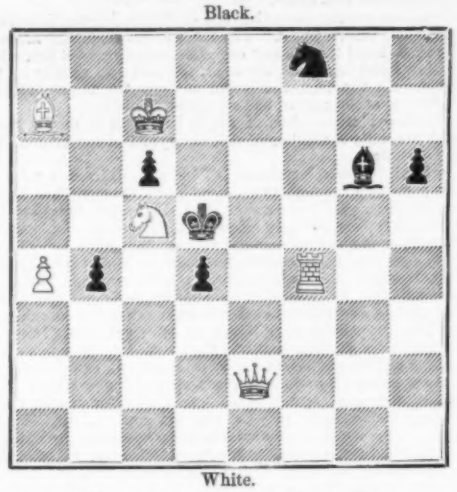
THE programme for the Problem Tournament of the New American Chess and Problem Association has been received, and will be given as soon as the powers that be authorize us to publish it. Our composers must set their wits to work and make it a grand success.

PROBLEM No. 20.

PRIZE FOR BEST PROBLEM IN HARTFORD GLOBE TOURNEY.

BY BEN. S. WASH, St. Louis.

Black.



White.

White to play and mate in three moves.

SOLUTIONS TO PROBLEMS.

No. 13.—BY JACOB ELSON.

WHITE.	BLACK.
1. Q to Q R 7	1. R x P ch
2. K to Kt 6	2. Any move
3. Mates	
	1. P x B
2. K to R 8	2. Q x B
3. P knights mating	
	1. Q to Kt 5 ch
2. B x Q ch	2. R to Q 3
3. B x R mate	
	1. R x Kt
2. B to Q 5 ch	2. R to K 6
3. P x Kt mate	
	1. B to B 3
2. B x R ch	2. B to K 4
3. R x B mate	
	1. R to K 6
2. K to R 8	2. R x Kt ch
3. P to B 8 (kts) mate	

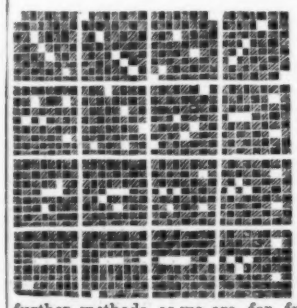
No. 14.—BY JACOB ELSON.

WHITE.	BLACK.
1. B to K 6	1. R x B ch
2. Kt to K 5	2. R x Kt ch
3. K to B 3	3. Any move
4. Mates	

LETTER "R."—BY JACOB ELSON.

WHITE.	BLACK.
1. Q x P ch	1. K x Q
2. Kt to K 3 ch	2. P x Kt
3. R to R 5 mate	

SCIENTIFIC QUEEN PROBLEM.



WE give this week the solution to the third problem of this series, the blank space on the small diagrams showing where the five queens may be placed so that the entire board will be commanded, from which it will be seen that there are sixteen different ways of posturing the queens so as to comply with the conditions of the problem. We would be pleased to learn if any of our readers have been able to discover still further methods, as we are far from feeling sure that the subject was exhausted by the short analysis we were able to bestow upon it.

HISTORICAL CHESS ANECDOTE.

COLONEL STEWART was wont to play chess a great deal with the Earl of Stair, who was very fond of the game. But an unexpected mate used to throw his lordship into such a passion, that he was ready to hurl a candlestick, or anything else that was near him, at his adversary; for which reason the Colonel always took care to be on his feet, to fly to the farthest corner of the room, before he said, "Checkmate, my Lord!"

IMPROMPTU SENTIMENT.

DELIVERED at the opening festival of the New York Chess Club, October, 1856.

By D. W. FISKE.

A beaker full of wine and love,
With gentle memories crowned,
To him who lived in days of old,
On orient Indian ground;
Unknown, yet honored everywhere,
Though nameless, yet renowned;
Whose genius, wit and skill combined
An after world to bless,
Who plucked from out his wondrous mind
The glorious game of chess.